Geostationary Operational Environmental Satellite (GOES)

R Series

Flight Project

Spacecraft

Contract Documentation Requirements List

July 26, 2007

Goddard Space Flight Center
Greenbelt, Maryland

GOES-R Spacecraft

Contract Deliverable Requirements

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1.0 Introduction

This Contract Data Requirements List (CDRL) Document defines the requirements for deliverable data to be provided by the Spacecraft contract. Section 1.1 includes definitions and instructions for distribution. Section 2 presents the CDRL item by item with due dates. Section 3.0 provides the Data Item Description (DID), as description of each item and describes use and preparation information.

1.1 Submission Definition

For purposes of this attachment, the following definitions apply:

1. Action Required

   A –Approval –Documents in this category **shall** require receipt by the GOES R Project within the time specified and written approval prior to Contractor implementation. Requirements for resubmission **shall** be as specified in letter(s) of disapproval. The GOES R Project will act on items requiring approval within fourteen days of receipt of the item.

   R –Review –Documents in this category **shall** be received by the GOES R Project within the time period specified, and will be subject to evaluation. These documents **shall** be implemented upon issuance unless otherwise noted. However, when an evaluation reveals inadequacies in a document, the Contractor **shall** correct the document as required.

   I –Information –Documents in this category will be used by the GOES R Project to determine current project status and progress and for future planning requirements.

2. Frequency

   The frequency for the data submission will be identified by one of the following items: Weekly (W), Bi-weekly (BW), Off Bi-Weekly (OBW), Monthly (M), Bi-Monthly (BM), Quarterly (Q), Annually (A), As Required (AR), As Generated (AG), See DID, Once per Flight Model (OFM).

3. Media

   Electronic media as agreed to by Government and Contractor, A softcopy of the CDRL item and Contractor transmittal letter **shall** be submitted electronically to the government via the agreed upon portal. All electronic deliverables **shall** contain scanned copy of Contractor signature and date signed.

   Other delivery methods may be required as detailed in the data item descriptions or by the COTR or CO.

Delivery Instructions

Delivery of the following items **shall** be to:

Ms. Clelia A Walker
Contracting Officer
Goddard Space Flight Center
Building 6 Room S138
Mailstop 417
Greenbelt, MD 20771

Clelia.A.Walker@nasa.gov
Business phone 301 286-1351
Fax number 301 286-9319

Delivery of all other items **shall** be to:

TBD
GOES R Project Documentation Control Center, Code 417
Building 6 Room TBD
Goddard Space Flight Center
Greenbelt, MD 20771

2.0 Spacecraft Contract Data Requirements (CDRL)

CDRL #	Title	Action Required	Frequency	Submission Initial	Submission Subsequent
	Program Management				
PM-01	Program Management Plan	R		30 DACA	
PM-02	Contractor's WBS Dictionary	A	AG	15 DACA	
PM-03	NASA Property in the Custody of the Contractors	R	Annually by October 15	60 DACA	Final: @ Contract End
PM-04	Small Business Subcontracting Plan	A	AR	Proposal	
PM-05	Small Business Subcontracting Plan Reports	R		Per Contract Clause: 52.219-90	
PM-06	New Technology Insertion and Reporting Plans	R	AR	60 DACA	
PM-07	New Technology Reports and Disclosures	R		Per Contract Clause: 1852.227-70	
PM-08	Master Action Item Database (MAID)	R	Weekly	15 DACA	
PM-09	Knowledge Capture Plan and Database	R		PDR -14 days	CDR -14 days
PM-10	Spares Plan	A		60 DACA	
PM-11	Spares Parts List	R	AG	PDR -14 days	
PM-12	Insurance Certification	R	Annually	7 DACA	
PM-13	Safety and Health Plan	A		Proposal	
PM-14	Safety and Health Report	A	AG	AG	
PM-15	GOES-R Data Books	A		LRR	

CDRL #	Title	Action Required	Frequency	Submission Initial	Submission Subsequent
	Program Reviews				
PR-01	Technical Interchange Meeting Minutes	I		Meeting +3 days	
PR-02	Teleconference Minutes	I		Meeting +3 days	
PR-03	Kick-Off Meeting Data Package	R		Meeting +7 days	
PR-04	Bi-weekly Status Reports & Teleconference Minutes	R	Bi-Weekly	15 DACA	
PR-05	Project Management Review (PMR) Data Package	R	Bi-Monthly	60 DACA	PMR -7days
PR-06	Peer Review Minutes	I		Meeting +7 days	
PR-07	Independent Review Data Package	R		1 Delivery As Requested	4 Subsequent Deliveries As Requested
	Design Reviews				
DR-01	System Requirements Review (SRR) Data Package	R		Preliminary: SRR –14 days	Update: SRR –7 days Final: SRR
DR-02	Preliminary Design Review (PDR) Data Package	R		Preliminary: PDR –14 days	Update: PDR –7 days Final: PDR
DR-03	Sub-System PDR Review Data Packages	R		Preliminary: Sub-System PDR –14 days	Update: Sub-System PDR –7 days Final: Sub-System PDR
DR-04	Critical Design Review (CDR) Data Package	R		Preliminary: CDR –14 days	Update: CDR –7 days Final: CDR

CDRL #	Title	Action Required	Frequency	Submission Initial	Submission Subsequent
DR-05	Sub-System CDR Review Data Packages	R		Preliminary: Sub-System CDR –14 days	Update: Sub-System CDR –7 days Final: Sub-System CDR
DR-06	Pre-Environmental Review (PER) Data Package	R		Preliminary: PER of each S/C –14 days	Update: PER of each S/C –7 days Final: PER of each S/C
DR-07	Satellite Pre-Shipment Review (PSR) Data Package	R		Preliminary: PSR of each S/C –14 days	Update: PSR of each S/C –7 days Final: PSR of each S/C
DR-08	Satellite Pre-Storage Review (PSTR) Data Package	R		Preliminary: PSTR of each S/C –14 days	Update: PSTR of each S/C –7 days Final: PSTR of each S/C
DR-09	Mission Operations Review (MOR) Data Package	R		Preliminary: MOR of each S/C –14 days	Update: MOR of each S/C –7 days Final: MOR of each S/C
DR-10	Senior Management Readiness Review (SMRR) Data Package	R		Preliminary: SMRR of each S/C –14 days	Update: SMRR of each S/C –7 days Final: SMRR of each S/C @ Launch –6 weeks
	Resource Management				
EVM-01	Earned Value Measurement System	R		Preliminary	Due 60 DACA

CDRL #	Title	Action Required	Frequency	Submission Initial	Submission Subsequent
	(EVMS) Plan			submission after notification of selection, but prior to contract award	Updated if EVM System Architecture changes
	Financial Management				
FM-01	Integrated Baseline Review (IBR) Data Package	R		IBR - 6 weeks (minimum)	
FM-02	Contract Performance Report	I	Formats 1-5 Monthly (no later than 15 calendar days after accounting calendar month end date)	Formats 1-5 Monthly (no later than 15 calendar days after accounting calendar month end date)	Formats 1-5 Monthly (no later than 15 calendar days after accounting calendar month end date)
FM-03	Financial Management Reports	R	Monthly (533M): due NLT 10 calendar days after the close of contractor's monthly accounting period. Quarterly (533Q): due on the 15th of the month preceding the quarter being	Monthly (533M): due NLT 10 calendar days after the close of contractor's monthly accounting period. Quarterly (533Q): due on the 15th of the month preceding the quarter being reported	Monthly (533M): due NLT 10 calendar days after the close of contractor's monthly accounting period. Quarterly (533Q): due on the 15th of the month preceding the quarter being reported

CDRL #	Title	Action Required	Frequency	Submission Initial	Submission Subsequent
			reported		
FM-04	Cost Analysis Data Requirement (CADRe)	R		Preliminary: 60 DACA	Update: IPDR –45 days; Update: CDR +15 days Update: Launch –30 days Final: Launch +90 days
FM-05	Manpower and Cost Report	R	Annually	30 DACA	
	Schedule Management				
MS-01	Spacecraft Master Schedule	R	Monthly	60 DACA	
	Configuration Management				
CM-01	Configuration Management Plan	R	AR	PDR –14 days	CDR –14 days
CM-02	Configuration Item Identification List	R	AR	75 Days After Contract Start	
CM-03	Drawing Tree	R	AR	PDR –14 days	CDR –14 days
CM-04	Document Tree	R	AR	PDR –14 days	CDR –14 days
CM-05	Configuration Control Board (CCB) Documentation	R	AR	PDR –14 days	CDR –14 days; Updates AR
CM-06	Configuration Change Requests (CCR) Class I	A	AG	AG	
CM-07	Configuration Change Requests (CCR) Class II	R	AG	AG	

CDRL #	Title	Action Required	Frequency	Submission Initial	Submission Subsequent
	Information Technology Management				
IM-01	Test Data Analysis System (TDAS) Definition & Delivery	R		TDAS 1st Use -60 days	
IM-02	TDAS Operations Manual	R		TDAS 1st Use -60 days	
IM-03	TDAS Training	R		TDAS 1st Use -30 days	
	Risk Management				
RM-01	Risk Management Plan	R		Proposal	SRR
RM-02	Risk List	R	AG	AG	
	Systems Engineering				
SE-01	Systems Engineering Management Plan	R		Proposal	90 DACA
SE-02	System Requirements Specification	A		SDR Dry Run –14 days	SDR
SE-03	Spacecraft Detailed Design Specification	R		PDR –14 days	CDR –14 days
SE-04	System Performance Verification Plan	A		Proposal	SDR –14 days
SE-05	Spacecraft to Instrument ICDs	R	AR	PDR –14 days	CDR –14 days
SE-06	Spacecraft to STDN / DSN ICD	A		PDR –30 days	CDR –30 days; SCTV –60 days
SE-07	Spacecraft Communications Services	A		PDR –30 days	CDR –30 days;

CDRL #	Title	Action Required	Frequency	Submission Initial	Submission Subsequent
	ICDs				SCTV –60 days
SE-08	Telemetry and Command Performance Analysis Report	A		PDR –30 days	CDR –30 days; SCTV –60 days
SE-09	Satellite Data Format Control Book Handbook	R		PER –30 days	
SE-10	Command Encryptor M & O Manual and Interface Description Document	R	AR	Subsystem CDR	
SE-11	Satellite Level Instrument Interface INR Analysis Plan	A		SRR –14 days	
SE-12	Satellite Level Instrument Interface INR Analysis Report and Data	A		PDR –14 days	CDR –14 days
SE-13	Satellite Level Instrument Interface INR Test Plan	A		CDR –14 days	
SE-14	Satellite Level Instrument Interface INR Test Report and Data	A		PSTR –3 months	
SE-15	Schematics Block Diagrams	A	AR	PDR	CDR Update: I&T TRR Update: GFP instrument integration PSR
SE-16	Contamination Control Plan	R		Proposal	PDR –14 days; CDR –14 days
SE-17	Spacecraft Contamination Model and Report	R	AR	PDR –14 days	CDR –14 days
SE-18	Electrostatic Discharge (ESD) Prevention Plan	A		PDR –14 days	CDR –14 days

CDRL #	Title	Action Required	Frequency	Submission Initial	Submission Subsequent
SE-19	Single Event Upsets (SEU) Prevention Plan	A		PDR –14 days	CDR –14 days
SE-20	Radiation Shielding and Dose Analysis Report	R	AR	PDR –14 days	CDR –14 days
	Safety & Mission Assurance				
MA-01	Mission Assurance Implementation Plan	A	AR	PDR –30 days	CDR –30 days
MA-02	As-Designed Parts List (ADPL)	A		CDR –10 days	
MA-03	As-Built Parts List (ABPL)	A		PSR –10 days	
MA-04	Parts and Materials Control Plan	A		PDR –30 days	
MA-05	Parts Control Program Plan	A		30 DACA	
MA-06	Material Usage Agreement/Stress Corrosion Form	A	AG		
MA-07	As-Designed Materials and Lubrication List	A	AG		
MA-08	As-Built Materials and Lubrication List	A	AG		
MA-09	Electrostatic Discharge Control Plan	A		PDR –14 days	CDR
MA-10	System Safety Program Plan	A		To GSFC: SRR	
MA-11	Safety Data Package (SDP)	A		PDR +30 days	CDR –30 days; PSR –60 days
MA-12	Missile System Pre-Launch Safety Package	A	Per Mission	PDR –45 days	CDR –45 days; PSR –120 days

CDRL #	Title	Action Required	Frequency	Submission Initial	Submission Subsequent
MA-13	Safety Non-Compliance / Waiver Requests	A	AG		
MA-14	Project Pre-Mishap Plan Input	A		PDR –15 days	PSR
MA-15	Mishap reports	R		Initial (per occurrence): +24 hours	Final (per occurrence): +3 days
MA-16	Safety Requirements Compliance Checklist	R		PDR +30 days	
MA-17	Preliminary Hazard Analysis	A		PDR +30 days	
MA-18	Operations Hazard Analysis	A		PER –45 days	
MA-19	Response to Alerts	A	AG		
MA-20	GIDEP Alert / NASA Advisory Disposition	R	AR		
MA-21	Failure Mode and Effects Analysis (FMEA) and Critical Items List (CIL) Report	R	AG	PDR –30 days	CDR –30 days Updates: AG
MA-22	Limited Life Items List	R	AG	PDR –30 days	CDR –30 days Updates: AG
MA-23	Request for Use of Multi-Mission or Previously Designed, Fabricated, or Flown Hardware	A		60 DACA	
MA-24	Parts Stress Analysis Report	R	AG	PDR –30 days	CDR –30 days Updates: AG
MA-25	Worse Case Analyses Report	R	AG	PDR –30 days	CDR –30 days Updates: AG

CDRL #	Title	Action Required	Frequency	Submission Initial	Submission Subsequent
MA-26	Reliability and Probabilistic Risk Assessment (PRA) Program Plan	R		30 DACA	PDR –30 days
MA-27	Reliability Block Diagrams and Predictions Report	R	AG	PDR –30 days	CDR –30 days Updates: AG
MA-28	Probabilistic Risk Assessment (PRA) Report	R	AG	PDR –30 days	CDR –30 days Updates: AG
MA-29	Trend Analysis Plan and Data Reports	R	AG	PDR –30 days	CDR –30 days Updates: AG
MA-30	Orbital Debris Assessment	A		PDR	CDR
MA-31	Verification Tracking Log	R	AR	PSR –30 days	
	Spacecraft				
	Spacecraft Management				
SC-MNGT-01	Component/Unit Level Design Specifications	I		Guaranteed Access As Generated –Not Delivered	
SC-MNGT-02	Spacecraft Photo and Video Plan	R	AG		
SC-MNGT-03	Component/Unit Level Test Plans	I		Guaranteed Access As Generated –Not Delivered	

CDRL #	Title	Action Required	Frequency	Submission Initial	Submission Subsequent
SC-MNGT-04	Component/Unit Level Test Procedures	I		Guaranteed Access As Generated –Not Delivered	
SC-MNGT-05	Component/Unit Level Data Packages	I		Guaranteed Access As Generated –Not Delivered	
SC-MNGT-06	Spacecraft Operations Handbook (SOH)	A		Launch –24 months	Launch –9 Months; Launch +6 Months [Incorporates Flight Data]
SC-MNGT-06	SOH Volume 1 : Mission Profile and Launch Operations	A		Launch –24 months	Launch –9 Months; Launch +6 Months [Incorporates Flight Data]
SC-MNGT-06	SOH Volume 2 : Contingency Operations	A		Launch –24 months	Launch –9 Months; Launch +6 Months [Incorporates Flight Data]
SC-MNGT-06	SOH Volume 3 : Spacecraft Description	A		Launch –24 months	Launch –9 Months; Launch +6 Months [Incorporates Flight Data]
SC-MNGT-06	SOH Volume 4 –On-Orbit Operations	A		Launch –24 months	Launch –9 Months; Launch +6 Months [Incorporates Flight Data]
SC-MNGT-06	SOH Volume 5 –On-Board Computer	A		Launch –24 months	Launch –9 Months;

CDRL #	Title	Action Required	Frequency	Submission Initial	Submission Subsequent
	(OBC) User's Operations and Maintenance Manual				Launch +6 Months [Incorporates Flight Data]
SC-MNGT-06	SOH Volume 6 –GOES R/S/T/TBD Spacecraft Specific Data	A		Launch –24 months	Launch –9 Months; Launch +6 Months [Incorporates Flight Data]
	Mechanical				
SC-MECH-01	Fields-of-View (FOV) Analysis Report	R		PDR –14 days	CDR –14 days
SC-MECH-02	Solid Model	R		PDR –14 days	CDR –14 days
SC-MECH-03	Critical Mechanical Clearance List and Model	R		PDR –14 days	CDR –14 days
SC-MECH-04	Alignment Plan	R		PDR –14 days	CDR –14 days
SC-MECH-05	Alignment Report	R		CDR –14 days	PSR –14 days
SC-MECH-06	Stress Analysis Reports	R		CDR –14 days	PSR –14 days
SC-MECH-07	Structural and Mechanical Subsystem Performance Analysis Report	R		PDR –14 days	Subsystem CDR –14 days
SC-MECH-08	Structural Math Models and Report	R		PDR –14 days	Subsystem CDR –14 days
SC-MECH-09	Mechanisms Performance Analysis Report	R		PDR –14 days	CDR –14 days
SC-MECH-10	Mass Properties Report	R	Monthly	SRR	
	Thermal				

CDRL #	Title	Action Required	Frequency	Submission Initial	Submission Subsequent
SC-THER-01	Reduced Integrated Satellite Thermal Model	R		PDR –6 months	PDR CDR –6 months; CDR; PSR
SC-THER-02	Reduced Integrated Satellite Thermal Model Report	R		PDR +2 months	CDR +2 months; PSR
SC-THER-03	Detailed Integrated Satellite Thermal Model	R		PDR –1 month	CDR –6 months; CDR –1 months; SCTB –2 months; SCTB +2 months
SC-THER-04	Thermal Subsystem and Performance Report	R		PDR +2 months	CDR +2 months; SCTB +2 months After 1 year in-orbit
SC-THER-05	Thermal Environment for GFP Instruments	R		SRR +2 months	CDR +3 months; SCTB +3 months
	GN&C				
SC-GN&C-01	GN&C Detail Description	R		CDR –14 days	PSTR –3 months
SC-GN&C-02	GN&C Algorithm Document	R		CDR –14 days	PSTR –3 months
SC-GN&C-03	GN&C Sensor Models	R		PDR –14 days	CDR –14 days
SC-GN&C-04	GN&C Performance Analysis Report	A		PDR –14 days	CDR –14 days
	C&DH				
SC-CD&H-01	Spacecraft Telemetry and Command Handbook	R		PER –30 days	

CDRL #	Title	Action Required	Frequency	Submission Initial	Submission Subsequent
SC-CD&H-02	Satellite Telemetry and Command Handbook	R		PER –30 days	
SC-CD&H-03	Satellite Telemetry and Command Database	R		PER –30 days	
	Communication				
SC-COMM-01	Detailed Block Diagrams of Communications Subsystem Units	A	AR	PDR	
SC-COMM-02	Communications Subsystem Level Test Data Package	A		Test Procedures @ Test –1 week	Complete Data Package @ Test +1 week
SC-COMM-03	Communications Subsystem Performance Analysis Report	A		PDR –30 days	CDR –30 days
SC-COMM-04	Communications Subsystem Component Computer Simulation Models	A		PDR –30 days	CDR –30 days
SC-COMM-05	Communications Link Budgets	A	AR	Proposal	PDR –30 days; Unit Test –10 days; SCTV –30 days; Launch +60 days
SC-COMM-06	Communications Subsystem Reliability	A		PDR –30 days	CDR –30 days
SC-COMM-07	Selection of Raw Data and GRB FEC Coding and Modulation	A		PDR –30 days	CDR –30 days
SC-COMM-08	Unit Test Data Reports	A		Unit Test Completion - 10 days	
SC-COMM-09	Multipaction and Corona Test and Analysis Report	A		PDR	CDR; Communication Subsystem Testing -

CDRL #	Title	Action Required	Frequency	Submission Initial	Submission Subsequent
					60 days
SC-COMM-10	Communications Subsystem Information Required for ITU and NTIA Filings	A		CDR +12 months	SCTV -10 days
SC-COMM-11	Communications Subsystem Test Data Reports	A	AG	Each Test -10 days	
	Electrical				
SC-ELEC-01	Electromagnetic Interference (EMI) / Electromagnetic Compatibility (EMC) Plan	A		PDR –14 days	CDR
SC-ELEC-02	Spacecraft Power Energy Balance Model and Analysis Report	R		Power Subsystem PDR –14 days	Power Subsystem CDR; PSR
SC-ELEC-03	Power Subsystem Analysis Report	A		Power Subsystem PDR –14 days	Power Subsystem CDR; PSR
SC-ELEC-04	Power Profile Report	R		SRR –14 days	PDR –14 days; Update: Monthly between PDR & CDR; Update: Quarterly between CDR & PSR; PSR –14 days
SC-ELEC-05	Solar Panel & Solar Array Assembly Output Power Predictions	A		SRR –14 days	PDR CDR PSR –14 days
SC-ELEC-06	Battery Design and Performance Analysis	A		SRR –14 days	+F257 PDR, CDR, PSR –14 days

CDRL #	Title	Action Required	Frequency	Submission Initial	Submission Subsequent
SC-ELEC-07	Battery Cell Acceptance Test Plan	A		Electrical Subsystem CDR –14 days	
SC-ELEC-08	Battery Cell Qualification Test Plan	A		Electrical Subsystem CDR –14 days	
SC-ELEC-09	Battery Acceptance Test Plan	A		Electrical Subsystem CDR –14 days	
SC-ELEC-10	Battery Qualification Test Plan	A		Electrical Subsystem CDR –14 days	
SC-ELEC-11	Battery Life Test Plan	A		6 months DACA	
SC-ELEC-12	Battery Handling, Storage, and Transportation Plan	A		PDR –14 days	
SC-ELEC-13	Solar Panel Qualification Test Plan	A		6 Months After Contract Award	
SC-ELEC-14	Solar Panel and Solar Array Acceptance Test Plan	A		PDR – 14 days	CDR – 14 days
	Propulsion				
SC-PROP-01	Propulsion Subsystem Performance Analysis Report	A		PDR –14 days	CDR –14 days
	Flight Software				
SC-FLSW-01	Software Management Plan	A		60 DACA	180 DACA; SWPDR; SWCDR; SWTRR; SWQR

CDRL #	Title	Action Required	Frequency	Submission Initial	Subsequent
SC-FLSW-02	Software Assurance Plan	A		30 DACA	90 DACA
SC-FLSW-03	Software Requirements Specification	I		SWPDR	SWCDR; SWTRR
SC-FLSW-04	Software Design Document	I		SWPDR	SWCDR; SWTRR
SC-FLSW-05	Software Test Plan	R		SWPDR	SWCDR; SWTRR
SC-FLSW-06	Software Test Procedures	R		SWCDR	SWTRR
SC-FLSW-07	Software Test Report	R		Conclusion Formal Software Qualification Testing	
SC-FLSW-08	Software Maintenance Manual	R		Final with Software Release Delivery Package	
SC-FLSW-09	Software Preliminary Design Review (SWPDR) Data Package	R		Initial (presentaion slides only to portal): SWPDR -5 days	Final (full package 10 hardcopies, 5 CDs, & portal): SWPDR
SC-FLSW-10	Software Critical Design Review (SWCDR) Data Package	R		Initial (presentation slides only to portal): SWCDR -5 days	Final (full package 5 hardcopies, 2 CDs, & portal): SWCDR
SC-FLSW-11	Flight Software Test Readiness Review (SWTRR) Data Package	R		Initial (presentation slides only to portal): SWTRR -3 days	Final (full package 10 hardcopies, 5 CDs, & portal): SWTRR
SC-FLSW-12	Software Qualification Review (SWQR)	R		Initial (presentation	Final (full package 5

CDRL #	Title	Action Required	Frequency	Submission Initial	Submission Subsequent
	Data Package			slides only to portal): SWQR -3 days	hardcopies, 2 CDs, & portal): SWQR
SC-FLSW-13	Software Release Delivery Package	R	AG		
SC-FLSW-14	Software Delivery & Operations Transition Plan	R		Initial: SWTRR	Update: PER; Final with Software Release Delivery Package
SC-FLSW-15	Software Architecture Document	R		Initial: 45 DACA	Update: SDR; Final: SWPDR
SC-FLSW-16	Maintenance, Test, and Operations Manual for the Flight Software Development Environment	R		Final with delivery of the FSDE	
SC-FLSW-17	Field Programmable Gate Arrays (FPGA) Development Plan	A		60 DACA	180 DACA
SC-FLSW-18	Field Programmable Gate Arrays (FPGA) Design Data Package	R		Delivered as generated for each FPGA	
	Magnetometer				
SC-MAGN-01	Spacecraft Magnetic Control Plan for Magnetometer Performance Assurance	I	AR	PDR –14 days	CDR –14 days;
SC-MAGN-02	Spacecraft Magnetic Field Model	A		PDR –14 days	CDR –14 days;

Ground Support Equipment

Simulator

CDRL #	Title	Action Required	Frequency	Submission Initial	Submission Subsequent
GS-01	Spacecraft Simulator Design Document	R	AR	Simulator Maintenance Training	Prelim: Delivery of S/C Simulator; Final: Simulator handover to government
GS-02	Spacecraft / Instrument Interface Simulator Specification	R	AR	PDR	CDR
GS-03	Spacecraft / Instrument Interface Simulator Drawings, Wiring, & Parts List	R	AR	PDR	CDR
GS-04	Spacecraft Simulator User's Operations and Maintenance Manual	R	AR	Simulator Delivery	Prelim: Simulator maintenance training; Final: Simulator handover to government
GS-05	Software Development & Validation Simulation Drawings, Wirings, and Parts List	R	AR	PDR	CDR
	Systems Integration and Test				
IT-01	Spacecraft Integration & Test Plan	A		PDR	CDR; CDR +60 days
IT-02	Spacecraft Launch Site Integration Plan (LSIP)	R		CDR –3 months	Launch Base Operations (LBO) –12 months; LBO –3 months
IT-03	Spacecraft Launch Commit Criteria	A		Launch –60 days	Launch –60 days

CDRL #	Title	Action Required	Frequency	Submission Initial	Submission Subsequent
IT-04	Subsystem Level Test Plans	A/R (See DID		CDR +60 days	
IT-05	Bus/Spacecraft Level Test Plans (Bus Level defined as spacecraft level testing pre-GFP instrument integration)	A/R (See DID		CDR +60 days	
IT-06	Satellite Level Test Plans (GFP instruments integrated)	A/R (See DID		CDR +60 days	
IT-07	Subsystem Level Test Procedures	A/R (See DID		CDR +60 days	
IT-08	Bus/Spacecraft Level Test Procedures	A/R (See DID		CDR +60 days	
IT-09	Satellite Level Test Procedures	A/R (See DID		CDR +60 days	
IT-10	Subsystem Level Post-Test Data Package	R		Test Completion +30 days	
IT-11	Bus/Spacecraft Level Post-Test Data Package	R		Test Completion +30 days	
IT-12	Satellite Level Post-Test Data Package	R		Test Completion +30 days	
IT-13	Transportation and Handling Plan & Procedures	R		60 days prior to first use (i.e. ship to launch site)	
IT-14	Ground Storage Plan	A		PSTR –30 days	
IT-15	Performance Trending Plan	A		PDR	CDR; CDR +60 days (TBR)
IT-16	Major Test Event (MTE) Development I&T Working Group Data Package	R		MTE meeting –2 weeks (MTE Development Meeting Schedule (TBD))	MTE meeting –2 weeks (MTE Development Meeting Schedule (TBD))

CDRL #	Title	Action Required	Frequency	Submission Initial	Submission Subsequent
IT-17	Test Readiness Review Data Package	R		Test start –14 days	
IT-18	Post Test Data Review Package	R		Test completion –14 days	
IT-19	GFP Instrument Safe-To-Mate Test Plan	A		PDR	CDR; CDR +90 days
	Launch Vehicle Integration (SC to LV Contractor Inputs)				
IT-20	Spacecraft/Launch Vehicle Interface Requirements Document (IRD)	A		Proposal	PDR –3 months; CDR
IT-21	Spacecraft Mission Insignia	A		Launch –16 months	
	Launch Operations				
	Post Delivery Support				
PS-01	Orbital Activation Plan	R		CDR	MOR
PS-02	Flight Operations Training Plan	A		Proposal	
PS-03	Spacecraft Training Program Plan	R		PER	
PS-04	Spacecraft Mission Operations Plan	R		Launch –12 months: 1st Satellite	Launch –12 months: each additional Satellite

CDRL #	Title	Action Required	Frequency	Submission Initial	Submission Subsequent
PS-05	Spacecraft On-Orbit Storage Plan	R		CDR –14 days	PSR
PS-06	Spacecraft De-orbit Plan	R		PDR –14 days	CDR –14 days
PS-07	Spacecraft Ground System Test Data	A		CCR	
PS-08	Spacecraft Engineering Handover Review	R		Launch +21 days: 1st Satellite	Launch +21 days: each additional Satellite

Special Studies & Tasks

Education & Public Outreach

Effective Date: (Date of last signature)

3.0 Data Item Descriptions

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
PM-01	Program Management Plan

3. Use:

Describes how the Program is organized and managed. It provides the management structure, its system of operation, responsible lines of communications, and key personnel assignments.

4. Use:

The Program Management Plan **shall** address the overall organization, management approach, and structure of the GOES-R Program plus its interrelationships with the parent company and the subcontractors, and relationship with the Government.

The Program Management Plan **shall** describe how and where the program will operate during all phases of the contract.

The Program Management Plan **shall** delineate how the requirements of the Statement of Work (SOW) will be achieved and include a description of planned activities for identifiable SOW requirements.

The planned work in the Program Management Plan **shall** follow a comprehensive and product-oriented Work Breakdown Structure (WBS).

The Program Management Plan **shall** describe the concept of the nature of the tasks and related potential problems. Discuss the approach to problem avoidance and/or solution. Address the degree to which proposed personnel and procedures are proven through similar experience.

The Program Management Plan **shall** address interfaces with the Government and with any Government Furnished Property (GFP) suppliers.

The Program Management Plan **shall** indicate critical paths, long-lead items and significant milestones down to at least the lowest level of the CWBS.

The Program Management Plan **shall** indicate the need for additional definition of spacecraft and mission, and when this information is required to avoid schedule slippage.

The Program Management Plan **shall** include graphical displays such as flow diagrams, CWBS, logic networks, etc., to reduce verbal descriptive material.

The Program Management Plan **shall** provide an organizational chart(s) and sufficient supplemental narrative to describe fully the organization proposed for carrying out the Program showing inter-relationships of technical management, business management, and subcontract management, from lower level through intermediate management to top-level management with detailed explanation of:

1. The authority of the GOES-R Program Manager relative to other ongoing programs and applicable support organizations within the company structure. Discuss the program manager's control over essential resources

and functions necessary to accomplish the work.

2 How and by whom interdepartmental work will be monitored and the authority of the program manager over interdepartmental work.

3 Process to be followed by the program manager in obtaining decisions beyond his/her authority and in resolving priority conflicts for resources and functions not under the program manager's direct control such as personnel, finances, and facilities.

4 The Program team members with names, functions, and short resume.

The Program Management Plan **shall** provide contractual procedures proposed for the Program to effect administrative and engineering changes, describing any differences from existing procedures.

The Program Management Plan **shall** describe management techniques to be employed in minimizing program costs and schedule impacts, including controls to be exercised over subcontractors and suppliers. It **shall** describe how issues will be surfaced in a timely manner and at the proper levels.

The Program Management Plan **shall** discuss and illustrate the proposed GOES-R Mission Assurance organizational structure, including staffing plans, reporting channels, authority and responsibilities, and management visibility.

The Program Management Plan **shall** discuss whether the technical, test, manufacturing and system safety/quality assurance/ reliability/ configuration management personnel required for this program (as indicated in your proposed labor hours) are presently on payroll and immediately available for this work.

The Program Management Plan **shall** state the number and kind of persons who would have to be hired, and plans to obtain them.

The Program Management Plan **shall** state the independence of the system safety/quality assurance functions.

The Program Management Plan **shall** explain/describe the schedule administration/control.

The Program Management Plan **shall** describe how the schedules are developed, maintained and updated.

The Program Management Plan **shall** explain the internal review cycle of the scheduling process.

The Program Management Plan **shall** explain how internal audits/reviews ensure that scheduling data reported to the Government accurately reflects the work status.

The Program Management Plan **shall** describe how subcontracts will be managed and reviewed, and describe the performance milestones of each.

The Program Management Plan **shall** address the design review process.

The Program Management Plan **shall** list and describe the planned subsystem reviews.

The Program Management Plan **shall** address the Contractor's approach to performance verification.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
PM-02	Contractor's WBS Dictionary

3. Use:

To facilitate program planning and control and for financial and technical reporting

4. Preparation Information:

The Contractor’s Work Breakdown Structure (WBS) Diagram **shall** document Government accepted changes to the Government WBS and Dictionary with an updated WBS diagram and description of task elements.

The Contractor’s WBS Diagram **shall** define all work included in the GOES-R development life cycle

The Contractor’s WBS Diagram **shall** be product-oriented and hierarchically relate all work, products, and end items.

The Contractor’s WBS Diagram **shall** provide a framework for project work definition to a level of detail consistent with cost, schedule, technical, and risk oversight as desired by contractor’s management and required by Earned Value Management.

The Contractor’s WBS Diagram **shall** contain a companion WBS dictionary that describes the overall structure and content of each individual element of the WBS.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:

PM-03

2. Title:

NASA Property in the Custody of the Contractors

3. Use:

For budget, cost and property control

4. Preparation Information:

The NASA Property in the Custody of the Contractors report **shall** consist of NASA Form 1018 in accordance with NFS 1845.505-14, the instructions on the form, subpart 1845.71, and any supplemental instructions for the current reporting period issued by NASA.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. **CDRL No.:**	2. **Title:**
PM-04	Small Business Subcontracting Plan

3. Use:

To establish goals for subcontracting with small businesses.

4. Preparation Information:

The Small Business Subcontracting Plan **shall** be in accordance with FAR 52.219-9, Alt.II.

The Small Business Subcontracting Plan **shall** show status of all relevant contracts, with justification for the amount towards the various small business concerns.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
PM-05	Small Business Subcontracting Plan Reports

3. Use:

To report performance against goals for subcontracting with small businesses.

4. Preparation Information:

The Small Business Subcontracting Plan Reports **shall** follow the Individual Subcontract Reports (ISRs) and Summary Subcontract Reports (SSRs) in accordance with FAR 52.219-9, Alt.II; and GSFC 52.219-90.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: **2. Title:**

PM-06 New Technology Insertion and Reporting Plans

3. Use:

Defines contractor plan for reporting new technology to the Government in accordance with provisions and requirements set forth in the contract

4. Preparation Information:

The New Technology Plan **shall** provide the size and nature of the scientific and technological efforts in which inventions, discoveries, improvements and innovations may be expected. This Includes the scientific disciplines involved in these efforts, and summarize the technical problems to be solved that are most likely to generate new technology.

The New Technology Plan **shall** emphasize new technology reporting by the top levels of management of the organization, and specific means (e.g., company directives, newsletters, etc.) to be used to communicate such emphasis to the organization.

New Technology Plan **shall** provide the organizational placement and qualifications of (a) the individual(s), assigned as company Technology Utilization/New Technology representative(s), and their staffs, and of (b) any others having substantial and specific responsibility for new technology reporting. Describe all significant organization relationships.

New Technology Plan **shall** prove the plans for both the initial and continuing indoctrination of senior project personnel, supervision, and other appropriate technical personnel in the benefits, responsibilities, and details of technology reporting.

New Technology Plan **shall** provide the plans to establish, maintain, and follow active and effective procedures to ensure that reportable items are promptly identified and reported in a timely manner as required by the New Technology clause. Include plans for system(s) to ensure reporting of that new technology, which does not constitute invention (any new or improved products, devices, materials, processes, methods, scientific or technical computer programs, techniques, compositions, systems, machines, apparatuses, articles, fixtures, and tools are reportable, whether or not they constitute invention).

New Technology Plan **shall** provide the details of actual documentation of reportable items, and the methods by which they will be reported. Include plans for (a) submission of sufficient detail to permit evaluation of the novelty and potential usefulness of the reportable items, (b) avoiding unnecessary re-documentation by inclusion of existing documents or abstracts there from.

New Technology Plan **shall** provide the level of effort anticipated. (Quarterly/monthly rates and estimated disclosure output rates are desirable.)

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
PM-07	New Technology Reports and Disclosures

3. Use:

To report new technology developed under the contract

4. Preparation Information:

The New Technology Reports and Disclosures **shall** be in accordance with NFS 1852.227-70

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:

PM-08

2. Title:

Master Action Item Database (MAID)

3. Use:

To provide responses to action items assigned to the contractor.

4. Preparation Information:

The MAID **shall** contain at least the following sections: title, due date, creation date, description, numbering scheme, creator, assigned to, status, notes section, and importance rating (i.e. green, yellow, red).

The MAID **shall** be created in Microsoft Excel format and submitted electronically to the GOES-R government portal.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
PM-09	Knowledge Capture Plan and Database

3. Use:

Indicate how contractor will identify lessons learned and knowledge for sustaining engineering

4. Preparation Information:

The Knowledge Capture Plan **shall** describe how lessons learned from GOES-R development, integration, and test will be captured, dispositioned, and communicated.

The Knowledge Capture Plan format is left to Contractor discretion and **shall** be submitted in Microsoft Word/Excel via the GOES-R government portal.

The Knowledge Capture Plan **shall** describe how training will be performed to convey lessons learned as they apply to the development, integration, and test of future GOES-R flight models.

The Knowledge Capture Plan **shall** describe how lessons learned will be captured and applied to subcontractor development of critical subassemblies and assemblies (e.g., FPAs).

The Knowledge Capture Plan **shall** describe the overall training plan.

The Knowledge Capture Database **shall** contain lessons learned from prior and existing contractor and government programs.

The Knowledge Capture Database **shall** have mitigation actions and list the responsible team member for each lesson learned.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
PM-10	Spares Plan

3. <u>Use:</u>

Provide the Program with contingency for unplanned components/subsystem anomalies of failures.

4. <u>Preparation Information:</u>

The Spares Plan **shall** address the contractor’s approach to sparing philosophy for the program.

The Spares Plan **shall** address to what configuration level they plan to spare, schedule for spare procurement, and guidelines for utilizing spares.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
PM-11	Spares Parts List

3. <u>Use:</u>

To review contractor's spares list

4. <u>Preparation Information:</u>

The Spare Parts List **shall** define and justify the contractor's position for the spares proposed for the ABI program.

The Spare Parts List **shall** also present the schedule and method for obtaining the spares.

The Spare Parts List **shall** include the Contractor's part numbers, the Original Equipment Manufacturer's (OEM) part numbers, Commercial/Government Entity (CAGE) codes and part numbers for other parts.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
PM-12	Insurance Certification

3. Use:

To verify that the contractor maintains workers' compensation, employer's liability, comprehensive general liability (bodily injury), and comprehensive automobile liability (bodily injury and property damage) insurance

4. Preparation Information:

The Insurance Certification **shall** contain a letter certifying the maintenance of insurance policies and identifying the insurers.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
PM-13	Safety and Health Plan

3. Use:

Defines contractor plan to comply with Safety and Health provisions of the contract

4. Preparation Information:

The Safety and Health Plan **shall** be prepared in accordance with NFS 1852.223-73, "Safety and Health Plan".

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
PM-14	Safety and Health Report

3. <u>Use:</u>

To document any accident, incident, or exposure resulting in fatality, lost-time occupational injury, occupational disease, contamination of property beyond any stated acceptable limits

4. <u>Preparation Information:</u>

The Safety and Health Report **shall** be in accordance with NFS 1852.223-70, Safety and Health; and GSFC 52.223-91, Safety and Health –Additional Requirements.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: PM-15

2. Title: GOES-R Data Books

3. Use:

This document is to provide an introduction to the GOES-R Spacecraft mission and a comprehensive overview of the GOES-R Spacecraft system. It is intended as a quick reference guide.

4. Preparation Information:

The GOES-R Data Books **shall** include a comprehensive overview of the satellite operational systems.

The GOES-R Data Books **shall** serve as a convenient desk top technical reference for people who work on the GOES Program and those needing a satellite system overview. It should contain all general characteristics of the missions, including at least the following types of information. The Data Book **shall** be updated prior to the launch of each satellite.

1) Overview of the GOES Mission
2) Spacecraft Configuration & Design Concepts
3) Subsystem and Payload Instrument Descriptions
4) All Ground terminal facilities, such as the CDA Station, Space Environment Center.
5) Data Product Descriptions
6) Launch trajectory, orbit requirements, and ground station location(s)
7) Subsystem Technical Performance Summary Tables

GOES-R Data Books are intended to be used as a reference guide and **shall** include top level block diagrams, simplified schematics, pictorials and narrative explanations suitable for public distribution.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
PR-01	Technical Interchange Meeting Minutes

3. Use:

Focused technical interaction and status reporting

4. Preparation Information:

The Technical Interchange Meeting Minutes **shall** identify:

a. Topics addressed with summary of key points and any conclusions or recommendations

b. Attendee List

c. Government direction

d. Any GFP requests

e. Actions with source, responsible party, recipient, and due date specified

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u> | **2. <u>Title:</u>**

PR-02 | Teleconference Minutes

3. <u>Use:</u>

Contract status evaluation

4. <u>Preparation Information:</u>

The Teleconference Minutes **shall** identify:

a. Topics addressed with summary of key points and any conclusions or recommendations

b. Attendee List

c. Government direction

d. Any GFP requests

e. Actions with source, responsible party, recipient, and due date specified

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
PR-03	Kick-Off Meeting Data Package

3. Use:

First, official government/contractor coordination meeting after contract award

4. Preparation Information:

The Kick-Off Meeting Data Package **shall** contain all presentation and supporting material developed by the contractor for the kick-off meeting.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
PR-04	Bi-weekly Status Reports & Teleconference Minutes

3. <u>Use:</u>

Contract status evaluation

4. <u>Preparation Information:</u>

The Bi-weekly Status Reports & Teleconference Minutes **shall** indicate the status of the contract as of close of business the preceding Friday, including a summary of progress made.

The Bi-weekly Status Reports & Teleconference Minutes **shall** address the work completed during the week against the work planned for the week, and address recovery plans if necessary.

The Bi-weekly Status Reports & Teleconference Minutes **shall** include technical progress, including significant accomplishments and milestones reached.

The Bi-weekly Status Reports & Teleconference Minutes **shall** include problems encountered and proposed corrective action

The Bi-weekly Status Reports & Teleconference Minutes **shall** indicate any actual or anticipated slip in schedule

The Bi-weekly Status Reports & Teleconference Minutes **shall** include identification of any Class I or Class II changes

The Bi-weekly Status Reports & Teleconference Minutes **shall** detail the work planned for the next week and summarize the work planned for the next month.

The Bi-weekly Status Reports & Teleconference Minutes **shall** contain telecon minutes for any telecons occurring during the reporting period.

Note: The Bi-weekly Status Reports & Teleconference Minutes is intended to be timely and informal and should detail the above topics as changes or problems occur.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
PR-05	Project Management Review (PMR) Data Package

3. Use:

To summarize the progress since the previous Project Management Review

4. Preparation Information:

The Project Management Status Review Data Package **shall** include the following items:

a) Accomplishments since last review, including 20 milestone events depicting critical items of project status for the succeeding two months with a report on the previous two months milestone events
b) Schedule
c) Technical issues and concerns, including summaries of technical progress and descriptions of the current technical issues and concerns
d) Business issues and concerns, including personnel changes
e) Current problems and anticipated resolution
f) Open contract items
g) Open action items
h) Planned effort for next review period
i) Reliability and quality assurance information
j) Outstanding proposals
k) Mass properties and power summary
l) Flight processor resource utilization
m) Financial summary including PMS data and a summary of actual versus planned manpower
n) Subcontractor status including:
   - efforts under contract
   - efforts waiting contract award
   - changes to first tier and sub-tier contractors
   - change orders, problems, issues
   - pending subcontractor consent packages
o) A list of actions requested of GSFC management
p) Update of corporate changes, for example: early warning of
   - restructuring activities (including internal reorganizations)
   - indirect/direct rate changes
q) Risk assessment including approach for mitigation

Any additional data requested by GSFC

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
PR-06	Peer Review Minutes

3. Use:

To facilitate peer interaction within technical and programmatic disciplines

4. Preparation Information:

The Peer Review Minutes **shall** identify:

a. Topics addressed with summary of key points and any conclusions or recommendations

b. Attendee List

c. Government direction

d. Any GFP requests

e. Actions with source, responsible party, recipient, and due date specified

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	2. Title:
PR-07	Independent Review Data Package

3. Use:

The Independent Review will be held at the spacecraft and launch vehicle contractor's facility prior to the launch of each satellite. The purpose of the review is to have an independent panel of experts review the launch readiness of each satellite and launch vehicle.

4. Preparation Information:

The Independent Review Data Package **shall** provide a review of each satellite and launch vehicle prior to launch.

The Independent Review Data Package **shall** contain a readiness review of the launch support network, launch and post launch activities and the planned test plans and procedures.

The review requirements are described in the S-415-27 document, titled "Program Review Requirements for the GOES-N Program".

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
DR-01	System Requirements Review (SRR) Data Package

3. Use:

To evaluate the requirements, requirements flow-down, and the operational concepts and to validate the realism of the functional and performance requirements and their congruence with the system configuration selected to conduct the mission.

4. Preparation Information:

The SRR Data Package **shall** discuss contractor system level requirements, rationale, and flow-down plans to lower level requirements.

The SRR Data Package **shall** cover the GOES-R System Specification and the traceability matrix to applicable government requirements documents.

The SRR Data Package **shall** cover requirements for the GOES-R satellite, Ground Support Equipment, and ground test software.

The SRR Data Package **shall** show how the current concept meets all government specified requirements including interface requirements.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
DR-02	Preliminary Design Review (PDR) Data Package

3. Use:

The PDR is the first major review of the detailed design and is normally held prior to the preparation of formal design drawings. The PDR is held when the design is advanced sufficiently to begin some bread board testing and/or the fabrication of design models. Detail designs are not expected at this time, but systems engineering, resource allocations, and design analyses are required to demonstrate compliance with requirements. A presentation of the design and interfaces by means of block diagrams, signal flow diagrams, schematics, logic diagrams, error budgets, link margins, first interface circuits, packaging plans, configuration and layout sketches, analyses, modeling, and any early results are required. Supporting data and analyses for mechanical, power, thermal, and electronic design: load, stress, margins, reliability assessments, should be shown. Software requirements, design, structure, logic flow diagrams, Central Processing Unit (CPU) loading, design language and development systems need to be specified. Parts selection, de-rating criteria, and radiation hardness, are an important part of the PDR. The identification of single point failure modes need to be assessed as well as critical design areas which may be life limiting. Robustness of the selected design needs to be shown.

4. Preparation Information:

The Preliminary Design Review Package **shall** address the following minimum items:

1) Payload Instruments and Payload Communications Systems/Technical Objectives, Requirements General Specification
2) Closure of Actions from Previous Review/Changes since the last review
3) Performance Requirements
4) System-Level Error Budgets, including error allocations to subsystem and components
5) Data rates, Telemetry List, Command List, EMI/EMC
6) Interface Requirements
7) Mechanical/Structural Design, Analyses, and Life Tests
8) Electrical, Thermal, Optical/Radiometric Design and Analyses
9) Software Requirements and Design
10) Ground Support Equipment Design
11) System Performance Budgets
12) Design Verification, Test Flow and Calibration/Test Plans
13) Mission and Ground System Operations
14) Launch Vehicle Interfaces and Drivers
15) Parts Selection, Qualification, and Failure Mode and Effects Analysis (FMEA) Plans
16) Contamination Requirements and Control Plan

17) Safety, Quality Control, Reliability and Redundancy
18) Materials and Processes
19) Acronyms and Abbreviations
20) Specification and Drawing Trees
21) Mass Properties Report
22) Power Profile Report
23) Single Point Failure Modes
24) Requirements Traceability Matrix
25) GFP Instrument Interface Design, including analyses supporting design choices
26) System grounding plan for spacecraft and GFP instrument power and signal lines
27) Compatibility with Atlas and Delta launch vehicle families

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
DR-03	Sub-System PDR Review Data Packages

3. Use:

The Sub-System PDR is the first major review of the detailed design and is normally held prior to the preparation of formal design drawings. The Sub-System PDR is held when the design is advanced sufficiently to begin some bread board testing and/or the fabrication of design models. Detail designs are not expected at this time, but systems engineering, resource allocations, and design analyses are required to demonstrate compliance with requirements. A presentation of the design and interfaces by means of block diagrams, signal flow diagrams, schematics, logic diagrams, error budgets, link margins, first interface circuits, packaging plans, configuration and layout sketches, analyses, modeling, and any early results are required. Supporting data and analyses for mechanical, power, thermal, and electronic design: load, stress, margins, reliability assessments, should be shown. Software requirements, design, structure, logic flow diagrams, Central Processing Unit (CPU) loading, design language and development systems need to be specified. Parts selection, de-rating criteria, and radiation hardness, are an important part of the Sub-System PDR. The identification of single point failure modes need to be assessed as well as critical design areas which may be life limiting. Robustness of the selected design needs to be shown.

4. Preparation Information:

The Sub-System Preliminary Design Review Packages **shall** address the following minimum items, as applicable:

1) Payload Instruments and Payload Communications Systems/Technical Objectives, Requirements General Specification
2) Closure of Actions from Previous Review/Changes since the last review
3) Applicable derived requirements, requirement flow-down and traceability
4) Performance Requirements
5) Sub-System-Level Error Budgets, including error allocations to subsystem and components
6) Data rates, Telemetry List, Command List, EMI/EMC
7) Interface Requirements
8) Mechanical/Structural Design, Analyses, and Life Tests
9) Electrical, Thermal, Optical/Radiometric Design and Analyses
10) Software Requirements and Design
11) Ground Support Equipment Design
12) System Performance Budgets
13) Design Verification, Test Flow and Calibration/Test Plans
14) Mission and Ground System Operations
15) Launch Vehicle Interfaces and Drivers

16) Parts Selection, Qualification, and Failure Mode and Effects Analysis (FMEA) Plans
17) Contamination Requirements and Control Plan
18) Safety, Quality Control, Reliability and Redundancy
19) Materials and Processes
20) Acronyms and Abbreviations
21) Specification and Drawing Trees
22) Mass Properties Report
23) Power Profile Report
24) Single Point Failure Modes
25) Requirements Traceability Matrix
26) GFP Instrument Interface Design, including analyses supporting design choices
27) System grounding plan for spacecraft and GFP instrument power and signal lines
28) Compatibility with Atlas and Delta launch vehicle families

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: DR-04

2. Title: Critical Design Review (CDR) Data Package

3. Use:

The CDR is held near the completion of the engineering model (if applicable) and bread board development stage. This should be prior to any design freeze and before any significant fabrication activity begins. The CDR presents a final detailed design using substantially completed drawings analyses and bread board/engineering model evaluation testing to show that the design will meet the final performance and interface specifications and the required design objectives. The CDR should represent a complete and comprehensive presentation of the entire design. It should present the final design and interfaces by means of block diagrams, power flow diagrams, signal flow diagrams, interface circuits, layout drawings, software logic flow and timing diagrams, design language, modeling results, bread board and engineering model test results and changes required to the design the presented at the PDR. Final estimates of weight, power, and volume are to be presented. Final calculations for mechanical loads, stress, torque margins, thermal performance, radiation design and expected lifetime are to be presented. Final software requirements and updated system performance estimates should also be presented. Parts selection, de-rating criteria, and screening results, calculated reliability and the results of a Failure Modes and Effects Analysis (FMEA) are to be presented. The CDR should include all of the items specified for a PDR, updated to the final present stage of development process, plus the additional data requirements described below in the "4. Preparation Information:" block below. It provides detailed analysis of the physical design of each electrical, electronic, and electromechanical component in the spacecraft bus system. It provides detailed analysis of all spacecraft subsystems.

4. Preparation Information:

The Critical Design Review Package **shall** address the following minimum items.

1) Evolution and Heritage of the Final Design
2) Combined Optical, Thermal, and Mechanical Budgets or Total System Performance
3) Closure of Actions from the Previous Review
4) Interface Control Documents
5) Final Implementation Plans including: Engineering Models, Prototypes, Flight Units, and Spares
6) Engineering Model/Breadboard Test Results and Design Margins
7) Completed Design Analyses
8) Qualification Test Plans
9) Launch Vehicle Interfaces
10) Ground Operations
11) System Safety
12) Reliability Analyses results: FMEA, Worst Case Analysis, Fracture Contro
13) Problem Areas

14) Schedules
15) Open Items
16) Specification and Drawing Trees
17) Mass Properties Report
18) Power Profile Report
19) Single Point Failure Modes
20) Requirements Traceability Matrix
21) GFP Instrument Interface Design, including analysis supporting design choices
22) System-Level Error Budgets, including error allocations to subsystems and components
23) System grounding plan for spacecraft and GFP instrument power and signal lines
24) Compatibility with Atlas and Delta launch vehicle families

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
DR-05	Sub-System CDR Review Data Packages

3. Use:

The Sub-System CDR is held near the completion of the engineering model (if applicable) and bread board development stage. This should be prior to any design freeze and before any significant fabrication activity begins. The CDR presents a final detailed design using substantially completed drawings analyses and bread board/engineering model evaluation testing to show that the design will meet the final performance and interface specifications and the required design objectives. The CDR should represent a complete and comprehensive presentation of the entire design. It should present the final design and interfaces by means of block diagrams, power flow diagrams, signal flow diagrams, interface circuits, layout drawings, software logic flow and timing diagrams, design language, modeling results, bread board and engineering model test results and changes required to the design the presented at the PDR. Final estimates of weight, power, and volume are to be presented. Final calculations for mechanical loads, stress, torque margins, thermal performance, radiation design and expected lifetime are to be presented. Final software requirements and updated sub-system performance estimates should also be presented. Parts selection, de-rating criteria, and screening results, calculated reliability and the results of a Failure Modes and Effects Analysis (FMEA) are to be presented. The CDR should include all of the items specified for a PDR, updated to the final present stage of development process, plus the additional data requirements described below in the "4. Preparation Information:" block below.

4. Preparation Information:

The Sub-System Critical Design Review Package **shall** address the following minimum items.

1) Evolution and Heritage of the Final Design
2) Combined Optical, Thermal, and Mechanical Budgets or Total Sub-System Performance
3) Closure of Actions from the Previous Review
4) Interface Control Documents
5) Final Implementation Plans including: Engineering Models, Prototypes, Flight Units, and Spares
6) Engineering Model/Breadboard Test Results and Design Margins
7) Completed Design Analyses
8) Qualification Test Plans
9) Launch Vehicle Interfaces (if applicable)
10) Ground Operations
11) System Safety
12) Reliability Analyses results: FMEA, Worst Case Analysis, Fracture Control
13) Problem Areas
14) Schedules
15) Open Items

16) Specification and Drawing Trees
17) Mass Properties Report
18) Power Profile Report
19) Single Point Failure Modes
20) Requirements Traceability Matrix
21) GFP Instrument Interface Design, including analysis supporting design choices
22) Sub-System-Level Error Budgets, including error allocations to subsystems and components
23) Sub-System grounding plan for spacecraft and GFP instrument power and signal lines
24) Compatibility with Atlas and Delta launch vehicle families (if applicable)

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: DR-06

2. Title: Pre-Environmental Review (PER) Data Package

3. Use:

The PER is required prior to the start of formal environmental testing. The purpose of the PER is to evaluate the planned test/calibration program and test flow to assure that it meets the program needs and to assure that a proper baseline of performance of the spacecraft to be tested has been established, and the spacecraft is ready to begin a qualification test program to demonstrate end-to-end or system performance. All performance liens, waivers, action items, malfunction reports and open items should be closed or dispositioned. Could-Not-Duplicate (CND) items should not be closed and their discussion or risk assessment should include what fault tree was done, possible causes, testing/on-orbit impacts, as well as "can we see it" in the follow-on test phases. The test verification matrix, including measurement tolerances, stimuli, contamination control, and results from the Comprehensive Performance Test (CPT) should be discussed along with the final results of any life tests. Failure free operating time on the item to be tested should be presented.

Following a successfully completed PER and the close-out of any remaining items, the hardware is ready to begin its environmental qualification or acceptance test program.

4. Preparation Information:

The PER Data Package should address the following minimum items.

1) Changes since the Critical Design Review
2) Program Status and General Test Readiness
3) Test Plans and Procedures
4) Test Objectives/Conditions/Levels/Configuration
5) Test Facilities and Certification
6) Test Fixtures and Support Equipment
7) Instrumentation
8) Success/Abort Criteria
9) Test Flow including: Calibration, Number of Thermal/Vacuum Cycles, where the CPTs will be performed and thermal analysis showing that thermal test objectives can be met, and length of time required for transitions.
10) Compliance with or Status of Test Verification Matrix
11) Schedule
12) Documentation Status
13) Functional and Environmental Test History of the Hardware
14) Product Assurance and Safety
15) Previous Anomalies, Deviations, Waivers, and their resolution

16) Identification of Residual Risk Items
17) Open Items and plans for close-out
18) Final Calibration
19) Mass Properties Report
20) Power Profile Report

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
DR-07	Satellite Pre-Shipment Review (PSR) Data Package

3. Use:

The PSR occurs prior to the shipment of the spacecraft to its destination. The purpose of the PSR is to assure the design of the spacecraft has been validated through the environmental qualification and/or acceptance test program, that all deviations, waivers and open items have been satisfactorily dispositioned and that the spacecraft, along with all the required documentation, operation procedures, etc., is ready for shipment. The results of system testing, alignment, calibration and end item performance are to be demonstrated and documented. The solutions to all problems encountered during the environmental test and validation program and the solution rationale are to be presented.

Satisfactory completion of the pre-shipment and the close-out of any actions from the review indicate the item is ready for shipment.

4. Preparation Information:

The PSR Data Package should address the following minimum items.

1) Any rework/replacement of hardware, regression testing, or test plan changes should be highlighted during the test flow discussions
2) Compliance with the test verification matrix
3) Measured Test Margins versus Design Estimates
4) Demonstrate Qualification/Acceptance Temperature Margins
5) Any data which has been trended to identify compliance with specification should be presented, especially if there has been a change or drift to the trend.
6) Total failure-free operating time of the item
7) Could-Not-Duplicate failures should be presented along with assessment of the problem and the residual risk that may be inherent in the item
8) Project assessment of any residual risk
9) Shipping Containers, Monitoring/Control Plans and Mode of Transportation
10) Ground Support Equipment Status
11) Post Shipment Plans
12) Launch Preparation Plan
13) Identification of all approved satellite waivers
14) Post Storage Data

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
DR-08	Satellite Pre-storage Review (PSTR) Data Package

3. Use:

The PSTR occurs prior to the storage of the spacecraft, if required. The purpose of the PSTR is to assure the design of the spacecraft has been validated through the environmental qualification and/or acceptance test program, that all deviations, waivers and open items have been satisfactorily dispositioned and that the spacecraft, along with all the required documentation, operation procedures, etc., is ready for storage. The results of system testing, alignment, calibration and end item performance are to be demonstrated and documented. The solutions to all problems encountered during the environmental test and validation program and the solution rationale are to be presented.

Satisfactory completion of the pre-storage and the generation of a mutually agreeable action item closure plan.

4. Preparation Information:

The PSTR Data Package **shall** address the following minimum items.

1) Any rework/replacement of hardware, regression testing, or test plan changes **shall** be highlighted during the test flow discussions
2) Compliance with the test verification matrix
3) Measured Test Margins versus Design Estimates
4) Demonstrate Qualification/Acceptance Temperature Margins
5) Any data which has been trended to identify compliance with specification should be presented, especially if there has been a change or drift to the trend.
6) Total failure-free operating time of the item
7) Could-Not-Duplicate failures should be presented along with assessment of the problem and the residual risk that may be inherent in the item
8) Project assessment of any residual risk
9) Storage Containers, Monitoring/Control Plans
10) Identification of all approved satellite waivers

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
DR-09	Mission Operations Review (MOR) Data Package

3. <u>Use:</u>

The MOR is the first of the two reviews which concentrate on the ground system and flight operations preparations. All mission-oriented operations will be addressed including payload instrument and communication systems, spacecraft and ground systems operations. The overall design and status of the ground system is reviewed to assure that the requirements for spacecraft payload data and spacecraft operations support and for data processing and analysis support are understood and that the proposed approach will meet the requirements. The operational interfaces between the ground system and flight system will be reviewed with respect to proper systems engineering of operational trade-offs, signal link margins, constraints, and modes of operation including safe modes. Mission integration of pre-launch test planning including all planned tests between the flight segment and the ground system will be reviewed. The relationship between planned ground system software releases/capabilities and planned tests with the flight segment will be included. The plans and status for flight operations team and science operations preparations will be presented.

The mission operations review should occur prior to significant integration and test of the flight system and ground system.

4. <u>Preparation Information:</u>

The Mission Operations Review Data Package **shall** address the following minimum items.

1) Objectives
2) Overall Schedule and Status including: Documentation (i.e. spacecraft operations concept, ground system requirements, flight operations and contingency plans and Interface Control Documents)
3) Closure of action items from previous reviews (e.g., Project-unique ground system reviews)
4) Mission, Payload Instruments and Communications Services, Spacecraft, Flight Software, and Ground System Overviews
5) Flight Software Maintenance Approach
6) Flight Operations Team build up and Training Plans
7) Pre-launch Test Plans including: RF and Project Operations Control Center (POCC) Compatibility Tests, Data Flow and End-to-End Tests, Simulations and exercises, Launch Site and Pad Tests
8) Launch and early orbit overview including deployment activities and coverage
9) In-orbit Checkout Overview
10) Project Database and Procedure Development
11) Spacecraft and Instrument Operations Constraints
12) Spacecraft Subsystem Level Activities
13) Mission Planning and Scheduling

14) On-board Data Memory Management
15) Real-time Operations including: Health and Safety Monitoring, Safe Mode Operation
16) Trend Analysis Plans including Reports and Archiving
17) Science Operations Planning, Data Processing and Analysis
18) Ground System Requirements and Development Status
19) Mission Readiness Testing
20) Preliminary List of all Launch Critical Facilities and Functions
21) Issues and Concerns
22) Specification and Drawing Trees
23) Mass Properties Report
24) Power Profile Report

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	2. Title:
DR-10	Senior Management Readiness Review (SMRR) Data Package

3. Use:

To ensure GSFC and NOAA management that the mission is ready to proceed to launch.

4. Preparation Information:

The SMRR Data Package **shall** contain the material to meet the requirements and purpose of the review defined in the SOW.

The SMRR Data Package **shall** verify that all system elements meet the requirements of the mission and are ready to proceed into final launch preparations.

The SMRR Data Package **shall** verify that testing to validate the readiness of the flight hardware and software has been completed with no unacceptable open issues.

The SMRR Data Package **shall** also cover:

1) Determination of completion of testing flight hardware and software
2) Verification of system requirements
3) Verification and documentation of hardware and software configuration
4) Identification of outstanding safety risks
5) Approved procedures for safe handling
6) Disposition of waivers, deviations, open issues
7) Compatibility of spacecraft and ground support equipment
8) End-to-end system level testing verification
9) Launch vehicle and launch operations readiness
10) On-orbit checkout and operational certification plans
11) Orbital operations plans
12) Mission operations, ground system and data processing system readiness
13) Evaluation of the acceptance data packages

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: EVM-01

2. Title: Earned Value Measurement System (EVMS) Plan

3. Use:

A fully validated EVM system is required as per NPR 7120.5D. It describes the program or project's implementation of its earned value management system.

4. Preparation Information:

The following references are given for the Earned Value Measurement System (EVMS) Plan:

- NPR 7120.5D, Program/Project Management Processes and Requirement
- NFS 1852.234-2, Earned Value Management System
- American National Standards Institute/Electronic Industries Association(ANSI/EIA)748-A

The EVMS Plan **shall** be available in hardcopy or electronic media format upon request.

The EVMS Plan **shall** demonstrate the use and understanding of the contract's overall financial and project management system with regard to EVMS at all levels of management.

The EVMS Plan **shall** identify policies, methods, procedures, and training utilized to meet the requirements of NPR 7120.5D and NPR 9501.2D (NF533).

In the EVMS Plan and supporting documentation, the contractor **shall** describe the program or project's implementation of its earned value management system.

The EVMS Plan **shall** address processes for managing technical scope, schedule, cost and risk; for conducting variance analysis; and for developing ongoing and comprehensive estimates at completion.

This EVMS Plan **shall** address the flow down of requirements to all major subcontracts consistent with the criteria and requirements defined in NPR 7120.5D.

The EVMS Plan **shall** ensure that the system provides for the results of all analyses based on EVM to be linked to or associated with the contractor's Risk Management System (as applicable).

Any cost and/or schedule risk being managed by the contractor's Project Manager **shall** correlate the results of the EVM analysis process to track, manage, and mitigate risk.

The EVMS Plan **shall** be revised at the Government's request, if a change in the EVM system architecture occurs or in the event of a major contract modification.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: FM-01

2. Title: Integrated Baseline Review (IBR) Data Package

3. Use:

An IBR is a joint assessment conducted by the Government PM and the contractor to verify the realism and accuracy of the PMB (Performance Measurement Baseline). This involves verifying the technical content of the baseline and assessing the realism and accuracy of the related resources (performance budget and IMS [Integrated Master Schedule]). The IBR is unlike the VR [Validation Review] that focuses on EVMS compliance with ANSI/EIA-748. Instead the IBR focuses on assessing the realism of the baseline. (DoD EVM Implementation Guide (October 2006), Section 2.4.1, p. 55)

4. Preparation Information:

The following references are given for the Integrated Baseline Review (IBR) Data Package:

- NPR 7120.5D, NASA Program and Project Management Processes and Requirement
- NFS 1852.234-2, Earned Value Management System
- Department of Defense Earned Value Management Implementation Guide (EVMIG) (http://guidebook.dcma.mil/79/EVMIG%20MAR%2007.doc October 2006)

An IBR Data Package **shall** be submitted in accordance with the IBR objectives stated above.

The IBR Data Package **shall** contain the following:

- Program/Business Management and Control Account Notebooks that incorporates the data products requested by the Project Office (hard copy and electronic copy)
- A baselined electronic version of the Integrated Master Schedule
- Contractor Earned Value Process Documentation (hardcopy and electronic)
- Two months of EV Performance data

Typical Content of Integrated Baseline Review Notebooks

Note: Most of these documents are simply ongoing operational documents gathered together into one notebook. Some documents will already reside in the EVMS Plan.

Program Management Data Notebook:

- Suggested notebook and presentation content:
  - Earned Value Management EVM Top Level Authority
  - Brief overview of EVM process.
  - Organization Charts –flow down as needed including EVM from subcontracts
  - Internal communication and action planning structure
  - Top Level Planning and Baseline assumptions
  - Program Percentages (LOE versus Discrete)
  - Program WBS
  - Program EOC RAM
  - Top Level Program Work Authorization and CAP
  - Program technical scope –flow down from SOW to Managers and CAMs

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- – EAC assumptions if different from negotiated BAC values
- – CPR Submittals
- – Program Schedule
  - Top level with vertical and horizontal traceability
  - Critical path
- – Risk Management approach
  - Current Top Risks
  - IPT Risk list and Self Assessment Procedures
- – Management Reserve levels and approach
- – Undistributed budgets, if any, and their work assignments
- – Funding Profile
- – Subcontractor Management Plan, if applicable
  - – Management review or reporting cycle
  - – Technical/Schedule/Cost/Risk Plan and Status
  - – EVM flow-down
  - – IBR results
  - – Any other key programmatics

Control Account Management (CAM) Data Notebook:

- Data content specific to the Control Account or Integrated Product Team

Technical Scope/Cost

- – Organization chart for the CA
- – RAM (show location in RAM with budget amounts)
- – Location in Contract Statement of Work
- – Work Authorization Documentation: trace to authorized budget
  - Show how work gets authorized from high to low levels
- – Time Phased Control Account Plan
  - WPs and PPs
  - Resource loading of task: work packages and planning packages
- – Baseline Metrics
  - Phased dollars by element of cost breakdown
  - Phased workforce profiles (FTEs)
- – Labor Reports

Control Account Management (CAM) Data Notebook: (cont'd)

Schedules

- – Flow-down of intermediate schedule into detailed schedules
- – Including any program critical path
- – Key handoffs
- – Schedule Metrics

Risk List

- – Current or anticipated risks in this CA or IPT

Earned Value Methodology

- – EV techniques and rationale
- – Cost performance report (>= 2 months)
- – Variance analysis reporting if applicable
- – Internal communication and action planning

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: FM-02

2. Title: Contract Performance Report

3. Use:

The Contractor Performance Report (CPR) provides the monthly status of performance data and estimates at complete, identifies approved changes to the Performance Measurement Baseline, and reports variances and projected variances at complete including explanatory analysis.

4. Preparation Information:

The following references are given for the Contract Performance Report:

- NPR 7120.5D, NASA Program and Project Management Processes and Requirement
- NFS 1852.234-2, Earned Value Management System
- DI-MGMT-81466A, Contract Performance Report dtd 3/30/2005 https://acc.dau.mil/CommunityBrowser.aspx?id=19544
- Department of Defense Earned Value Management Implementation Guide (EVMIG) (http://guidebook.dcma.mil/79/EVMIG%20MAR%2007.doc October 2006)

The CPR **shall** include data pertaining to all authorized contract work, including both priced and un-priced effort that has been authorized at a not-to-exceed amount in accordance with the Contracting Officer's direction.

The CPR **shall** separate direct and indirect costs and identify elements of cost for all direct reporting.

The CPR **shall** include Formats 1 -5, down to a WBS Level 4. A lower level of reporting may be required for elements that are classified as technical, schedule, or cost risk areas.

Earned value performance measurement data for Government and/or contractor-identified medium-and high-risk WBS items **shall** be reported on Format 1 of the monthly CPR until such time as both Government project management and the Contractor agree that they no longer represent medium or high risks.

The CPR **shall** be at a level where the risk resides in the WBS. For medium-and high-risk elements lower than Level 4, specific narrative variance analyses are not required unless specified as special interest.

To ensure an integrated approach to risk management, the data provided by this CPR DRD **shall** be in consonance with the Work Breakdown Structure (WBS), Integrated Master Schedule (IMS), Risk Management Processes, Plans and Reports (where required), Probabilistic Risk Assessment Processes and Reports (where required), the Cost Analysis Data Requirement (CADRe) and the Monthly/Quarterly Contractor Financial Management Reports (533/Q).

The Financial Management Reports **shall** include reconciliation between the 533M/Q and the Contractor Performance Report. This reconciliation may be included within the required CPR Formats.

CPR formats **shall** be completed according to the instructions outlined in DI-MGMT-81466A and the following forms: Format 1 (DD Form 2734/1); Format 2 (DD Form 2734/2); Format 3 (DD Form 2734/3); Format 4 (DD Form 2734/4); and Format 5 (DD Form 2734/5). Samples of these forms are available at: https://acc.dau.mil/CommunityBrowser.aspx?id=19543. Format 5: Variance analysis thresholds which, if exceeded, require problem analysis, narrative explanations and corrective action plan descriptions for all level three and other special interest WBS elements (in the previous paragraph). GOES-R variance analysis thresholds will initially be 10% (+or -) of both current and cumulative cost and schedule variance to date. The variance analysis thresholds may change once the GOES-R Project personnel evaluate the contractor's schedule and cost performance, and risk. Special emphasis should be placed in the variance analysis on cost and schedule growth linked to technical risks (e.g., technology development efforts; design engineering; integration; complexity; project management; systems engineering; duration constraints; etc.) identified by both the government and contractor.

Contractor format may be substituted for CPR formats whenever they contain all the required data elements at the specified reporting levels in a form suitable for NASA management use. The CPR **shall** be submitted electronically and followed up with a signed paper copy. The American National Standards Institute (ANSI) X12/XML standards (transaction sets 839 for cost and 806 for schedule), the United National Electronic Data Interchange for Administration, Commerce and Transport (EDIFACT, http://www.unece.org/trade/untdid/) equivalent, or any other electronic delivery method deemed acceptable to the GOES-R Project Office **shall** be used for Electronic Data Interchange.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
FM-03	Financial Management Reports

3. Use:

To provide data necessary for a) projecting costs and hours to ensure that dollar and labor resources realistically support project and program schedules; b) evaluating contractors' actual cost and fee data in relation to negotiated contract value, estimated costs, and budget forecast data; c) planning, monitoring, and controlling project and program resources; and d) accruing cost in NASA's accounting system. (per NPD 9501.2D)

4. Preparation Information:

The following references are given for the Financial Management Reports:

- NPD 9501.2D, NASA Contractor Financial Management Reporting
- Financial Management Reporting (GSFC 52.242-90)
- NASA Contractor Financial Management Reporting(1852.242-73)

The Monthly and Quarterly Financial Management Reports **shall** be prepared in accordance with the NASA Contractor Financial Management Reporting (1852.242-73) clauses and as supplemented by Financial Management Reporting (GSFC 52.242-90).

Financial Management Reports **shall** be provided down to WBS level 4. A lower level of reporting may be required for elements that are identified as technical, schedule, cost and risk areas and to support occasional special analyses (GAO or IG audits, project-level Cost Analysis Data Requirements).

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
FM-04	Cost Analysis Data Requirement (CADRe)

3. Use:

The Cost Analysis Data Requirement (CADRe) documents the programmatic, technical, and life cycle cost information for Category I and Category II Flight Systems and Ground Support Projects. It is the NASA version of the Department of Defense Cost Analysis Requirements Document (CARD). The CADRe is for both internal project use and for independent cost estimating.

The NASA Project Manager is responsible for the CADRe. Typical projects will make five CADRe submissions across the project life cycle (see page 8 at http://ceh.nasa.gov/downloadfiles/Web%20Links/CADRe%20Info.ppt). The CADRe requirement for the GOES-R Project is flowed down through this DID.

The CADRe is comprised of three parts:

- Part A contains general descriptive information about the project. The Part A template below provides the necessary guidance.
- Part B contains hardware and software technical parameters necessary to estimate the project's life cycle cost. The Part B template below provides the necessary guidance.
- Part C contains the project's life cycle cost estimate (LCCE). Part C represents the Project's cost estimate and the Project Manager is responsible for collecting the inputs from the various participants including Full Cost elements and submitting an integrated cost estimate.

4. Preparation Information:

The following references are given for the Cost Analysis Data Requirement (CADRe):

- NPR 7120.5D, NASA Program and Project Management Processes and Requirements
- NASA Cost Estimating Handbook (www.ceh.nasa.gov)

The required CADRe data for submission by the Contractor **shall** be CADRe Part B spreadsheet technical data required for the GOES-R Project to complete the full CADRe and some detailed cost data to support Part C. Most of these data will be available through technical documents presented at the PDR, CDR., etc. and cost data provided through NF533 and Contractor Performance Reports. The Part B Template and other information are available at ceh.nasa.gov.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
FM-05	Manpower and Cost Report

3. <u>Use:</u>

To provide assurance the Contractor's internal cost and schedule performance are consistent and controlled effectively

4. <u>Preparation Information:</u>

The Manpower and Cost Report **shall** list by name all individuals who charged to the GOES-R WBS and the hours charged by each individual.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
MS-01	Spacecraft Master Schedule

3. Use:

For understanding and mapping out in detail the most efficient way of melding together the design, test, hardware, and software elements of the flight equipment, GSE, S/C integration, data analyses and support functions, and documentation at the required program delivery times.

Schedule reports are used to plan, monitor, communicate status, and control all activities, including pertinent resources and facilities, necessary to accomplish assigned tasks in compliance with the GOES R spacecraft statement of work (SOW).

4. Preparation Information:

The Spacecraft Master Schedule **shall** provide the basis for reporting schedule status to the GOES Project Office.

Vertical traceability between the Master, Intermediate and Detailed networks and schedules should be established and maintained including a proper revisions process during the performance of this contract.

The following schedule reports (in tabular form and electronic media) **shall** be provided monthly.

1) Master Logic Network and Master Schedule: A time phased schedule portraying all significant events, activities, and milestones of the program. It reflects the overall time allocated to meet specific requirements and establishes the ground rules for implementing the total program. The master schedule **shall** summarize the schedule data and status information contained in the intermediate level logic network schedules and **shall** include baseline as well as actual/forecast start and finish dates for all subassemblies, significant activities, events and milestones. A master schedule bar chart, clearly depicting the critical path(s) and suitable for view graph presentation to management, **shall** also be provided.
2) Intermediate Logic Network and Schedules: The logic network schedules are an expansion of the master schedule and **shall** reflect all appropriate WBS elements. Intermediate Level Logic Network Schedules **shall** provide:
    a. Sufficient detail to permit identification of the elements necessary for overall accomplishment.
    b. Time phase the work elements of the WBS.
    c. Identify major interfaces between project organizations, functional departments, and associate contractors.
    d. Establish controlled intermediate milestones to adequately monitor progress.
    e. For each task/activity, the baseline start and completion dates; the current expected/planned start and completion dates, the number of work days required to accomplish the task, and the amount of float/slack in work days for each task, a unique activity identification number for each task, and a task description.
    f. The critical path **shall** be derived from the intermediate level logic network schedules.

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3) Detail schedules: These logic network and/or bar chart schedules are an expansion of the intermediate level logic network schedules and **shall** reflect all cost account plan activity (discrete effort only) schedules.
4) NASA directed change implementation schedules: Stand alone bar chart schedules clearly identifying all tasks associated with implementing a specific NASA directed change (design through incorporation of the directed change into hardware, software, firmware, and associated documentation). The change schedule **shall** be provided by the contractor once, and then the changes **shall** be incorporated into the detail, intermediate and master schedules.
5) Monthly schedule analysis narrative: The contractor **shall** submit a monthly narrative report describing the overall schedule position of the GOES spacecraft based on schedule float/slack analysis for each major subsystem/subassembly/assembly and compare current month completion date/float for that element with that of the prior month. The primary critical path **shall** be explained along with possible work-around and/or schedule risk mitigation plans being considered to maintain the schedule.
6) The contractor **shall** maintain a log book identifying all schedule changes (task additions, deletions, duration adjustments, changes to logic, etc.) to the schedule baseline documentation and **shall** provide this data to the NASA GOES Project Office upon request.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: CM-01

2. Title: Configuration Management Plan

3. Use:

Defines the contractor's configuration management system (including policies and procedures) that will be implemented for the GOES-R spacecraft project.

4. Preparation Information:

The Configuration Management Plan **shall** be prepared in accordance with the Contractor's practices.

The Configuration Management Plan **shall** describe in detail all configuration management processes, methods, and procedures the contractor intends to use on the GOES-R Spacecraft Project.

The Configuration Management Plan **shall** describe how hardware configuration management is accomplished and how consistency between product definition, the product's configuration, and the configuration management records is achieved and maintained throughout the applicable phases of the product's life cycle by the contractor. Note: The Software CM Plan is specifically called out as part of the Software Management Plan

The Configuration Management Plan **shall** describe the contractor's approach, methodology and application of configuration management principles and practices and **shall** include the following:

1) General product definition and scope
2) Description of configuration management activities and procedures for each of the following configuration management functions:
    a. Configuration Planning and Management
    b. Configuration Identification
    c. Configuration Change Management
    d. Configuration Status Accounting
    e. Configuration Verification and Audit
    f. Configuration Management of digital data
3) Organization, roles, responsibilities and resources
4) Definition of terms
5) Programmatic and organizational interfaces
6) Deliverables, milestones, and schedules
7) Subcontract flow down

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u> **2. <u>Title:</u>**

CM-02 Configuration Item Identification List

3. <u>Use:</u>

To identify all configuration items (CI) and computer software configuration items (CSCI) used on the GOES-R Spacecraft and to correlate those CI/CSCI to their specifications and requirements documents.

To establish a structure for controlling the configuration of the spacecraft and ground segment by identifying all Configuration Items (CI) and Computer Software Configuration Items (CSCI) used on the program and correlating those CI/CSCI to their Specification and test requirements documents.

4. <u>Preparation Information:</u>

The Configuration Item Identification List **shall** identify all CIs and CSCIs.

The Configuration Item Identification List **shall** conform to the following:

1) The Configuration Item Identification List **shall** be organized and broken down as follows:
   a. All system level CI and CSCI.
   b. All subsystem level CI and all CI/CSCI within each subsystem.
2) For each CI listed, the following information **shall** be provided:
   a. Assigned CI Number.
   b. The CI top drawing number.
   c. The CI nomenclature.
   d. The applicable specification number. For those CI not governed by a specification, the word "NONE" **shall** be entered in this column.
   e. Acceptance test procedure number and, if qualification tested, the qualification test procedure number. If the CI is neither acceptance nor qualification tested, the functional test procedure number should be entered in this column.
3) For each CSCI listed the following information **shall** be provided:
   a. Assigned CSCI Number
   b. The CSCI nomenclature.
   c. The NPR 7150.2 Classification assigned to the CSCI.
   d. The applicable software requirements specification number.
   e. Indication of whether any part of the CSCI is safety critical.
   f. Acceptance test procedure number and, if qualification tested, the qualification test procedure number. If the CSCI is neither acceptance nor qualification tested, the functional test procedure number should be entered in this column.
4) The Configuration Item Identification List **shall** be prepared in the contractor's format.

Effective Date: (Date of last signature)

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u> **2. <u>Title:</u>**

CM-03 Drawing Tree

3. <u>Use:</u>

For ready reference list of all GOES-R Satellite and GSE drawings.

4. <u>Preparation Information:</u>

The Drawing Tree **shall** list all drawings for the GOES-R Satellite and separately for the GSE.

The Drawing Tree **shall** be organized and identified to serve as a ready reference list.

The Drawing Tree **shall** identify drawings by name and number.

The Drawing Tree **shall** include a brief description of each drawing.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
CM-04	Document Tree

3. <u>Use:</u>

For ready reference list of all GOES-R Satellite and GSE documents.

4. <u>Preparation Information:</u>

The Document Tree **shall** list all documents for the GOES-R Satellite and separately for the GSE.

The Document Tree **shall** be organized and identified to serve as a ready reference list.

The Document Tree **shall** identify documents by name and number.

The Document Tree **shall** include a brief description defining the scope of each document

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
CM-05	Configuration Control Board (CCB) Documentation

3. Use:

To permit visibility of all changes in configured items (CI) and controlling documentation proposed by the contractor.

4. Preparation Information:

The CCB Documentation **shall** include the CCB Agenda, Data Packages, and Minutes.

The CCB Agenda **shall** include the date, time, location, subject, sponsor, and change control number of the items to be reviewed by the board.

The CCB Data Packages **shall** be attached for each change with the precise format and content that will be reviewed be the contractor's board.

The CCB Data Packages **shall** contain all relevant background material (including written agreements and memos between the Government and the contractor) and complete technical supporting analyses.

For the purpose of this DID, the term CCB **shall** mean the contractor's program-level CCB and any sub-board which is empowered to authorize the final disposition of an engineering change.

The CCB Minutes **shall** include the date, time, location, item subject, change control number, and CCB disposition of the changes reviewed.

The CCB Minutes **shall** include a list of actions generated from the CCB for each change

The CCB Minutes **shall** include the date it is to be completed.

For approved changes, the change classification and affectivity **shall** be specified.

When changes are disapproved, a reason(s) **shall** be included.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
CM-06	Configuration Change Requests (CCR) Class I

3. Use:

Class I changes are to be used as a vehicle for orderly processing of change requests to appropriate level of approval authority for disposition.

4. Preparation Information:

Class I Configuration Change Requests **shall** document proposed changes impacting form, fit, function, cost, schedules or performance per the Configuration Management Plan.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
CM-07	Configuration Change Requests (CCR) Class II

3. <u>Use:</u>

Class II changes are to be used as a vehicle for processing of all change requests not classified as Class I to appropriate levels for concurrence.

4. <u>Preparation Information:</u>

Class II Change Requests **shall** document all change requests that are not Level I changes and are not detrimental to the government per the Configuration Management Plan.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
IM-01	Test Data Analysis System (TDAS) Definition & Delivery

3. Use:

The Test Data Analysis System is used as a tool to assist NASA in the review and analysis of all data generated from integrated testing. The TDAS will allow remote review of this data from GSFC and on site at the contractor's facility.

4. Preparation Information:

The TDAS Definition and Delivery **shall** include the following items:

1) TDAS facility description –functional overview of TDAS
2) Boundary diagram –indicating NASA/Contractor demarcations
3) Network diagram –finalized network configuration w/updated hardware
4) Data flow diagram
5) Equipment and Rack diagrams
6) Hardware inventory
7) Software inventory
8) Server/work station list: functional role, software, services
9) Build documentation for all equipment
10) System Security Monitoring & Change Control
11) Data archive description primary and backup archive location
12) Account Request forms & Procedures for requesting TDAS accounts
13) TDAS Implementation Schedule

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
IM-02	TDAS Operations Manual

3. Use:

The TDAS Operations Manual is used to document the policies and procedures required to run the TDAS.

4. Preparation Information:

The TDAS Operations Manual **shall** include:

1) Standard Operating Procedures to run the hardware and software that make up the system. This **shall** include accessing, reviewing and storage of test data
2) Contingency procedures for anomalous operations
3) Constraints on hardware and software
4) Security policies and procedures required to maintain the integrity of the system

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
IM-03	TDAS Training Package

3. Use:

The TDAS Training Package will be used to train all designated personnel in the operation of the TDAS.

4. Preparation Information:

TDAS Training Package **shall** include materials and manuals to cover the following activities:

1) Class room instruction in the operation of the hardware and software that make up the TDAS. This **shall** include training on the actual TDAS equipment in the TDAS facility.

2) Instruction in the various tools developed to assist in data analysis

3) Instruction in the security tools and safeguards

4) Procedures for applying for access to the TDAS

5) Supplemental training for changes or upgrades to the various components of the TDAS

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: RM-01

2. Title: Risk Management Plan

3. Use:

The purpose of the Risk Management Plan is to define the continuous risk management process by which the developer identifies, evaluates and minimizes the risks associated with program, project, and/or mission goals.

4. Preparation Information:

The Risk Management Plan (RMP) **shall** be a configuration-controlled document.

The RMP **shall** include:

1) Overview of Introduction. Specify the program/project risk objectives and policy toward risk. Explain the purpose, scope, assumptions, constraints, key ground rules, and policy pertaining to the project continuous risk management process.

2) Overview of Process. Provide an overview of the continuous risk management process and information flow; describe how the continuous risk management process integrates and relates to other project management and system engineering activities. Include general risk mitigation strategies to be employed throughout project life cycle.

3) Organization. Show the organization, roles, and responsibilities of program, project, customer, and supplier key personnel with regard to continuous risk management. Document how team members will be trained in the application of risk management methodology.

4) Process Details. Provide the risk management process details and related procedures, methods, tools, and metrics. Include here, or in an appendix, the specific methodologies to be used for activities of continuous risk management: identify, analyze, plan, track, control, communicate and document. Include the process to be used for continual assessment of the project Risk Profile. Describe how risk information will be communicated both internally to the project staff and throughout the NASA management chain.

5) Documentation of Risks. Specify the format and data elements that will comprise the project Risk List (and/or Risk Database), how configuration control will be applied, and how the list will be used and updated. Tell how team members will be able to access the current list at any time. Include in the RMP the initial set of identified risks and the action plan (for research, acceptance, tracking, or mitigation) for each risk.

6) Key System Interfaces: Describe the relationship and interface of the continuous risk management process to schedule, financial, Earned Value Management, and other business reporting systems.

7) Appendix. Material that is too detailed or sensitive to be placed in the main body of text may be placed in an appendix or included as reference. Include the appropriate reference in the main body of the text. Appendices may be bound separately, but are considered to be part of the document and **shall** be placed under configuration control as such. Include an alphabetized list of the definitions for abbreviations and acronyms used in this document. Include an alphabetized list of definitions for special terms used in the document, i.e., terms used in a sense that differs from or is more specific than the common usage for such

Effective Date: (Date of last signature)

terms.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
RM-02	Risk List

3. Use:

The purpose of the Risk List is to define the information document information on risks associated with program, project, and/or mission goals.

4. Preparation Information:

The Risk List **shall** be a configuration-controlled document.

The Risk List **shall** include:

1) Description of the risk, including primary causes and contributors, actions embedded in the program or project to date to reduce or mitigate it, and information collected for tracking purposes.

2) Primary consequences should the undesired event occur.

3) Estimate of the probability of occurrence (qualitative or quantitative) together with the uncertainty of the estimate and the effectiveness of any implemented risk mitigation measures.

4) Additional risk tracking information including risk originator (person who initially identified the risk), risk classification (e.g., technical, cost, or schedule), risk owner (person responsible for tracking/mitigating risk), and risk timeframe (time period when mitigation action needs to be initiated).

5) Potential additional risk mitigation measures, which **shall** include a comparison of the cost of risk mitigation versus the cost of occurrence multiplied by the probability of occurrence.

6) Characterization of a risk as “acceptable” or closed **shall** be supported by a rationale (with the concurrence of the Government) that all reasonable mitigation options (within cost, schedule, and technical constraints) have been instituted and/or that risk has been reduced.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SE-01	Systems Engineering Management Plan

3. Use:

The contractor approved Systems Engineering Management Plan (SEMP) **shall** serve as the contractor's planned method of identifying and conducting all system engineering related activities under this contract.

4. Preparation Information:

The Systems Engineering Management Plan **shall** describe the overall lifecycle including the major systems engineering activities for each phase.

The Systems Engineering Management Plan **shall** describe critical decisions and activities.

The Systems Engineering Management Plan **shall** include approach for performing the system engineering activities especially where subcontracts are planned.

The Systems Engineering Management Plan **shall** describe methods utilized for communicating systems engineering activities, progress, status and results. (Include any periodic meeting or working groups.)

The Systems Engineering Management Plan **shall** list communication methods that are planned (e.g. meeting makers, tracking tools, email, and websites).

The Systems Engineering Management Plan **shall** describe the trade study methodology.

The Systems Engineering Management Plan **shall** describe the types of mathematical and or simulation models to be used.

The Systems Engineering Management Plan **shall** describe the scope, approach, methods, and procedures of the system used to implement the management of requirements.

The Systems Engineering Management Plan **shall** document how the contractor will track and trace requirements to all levels.

The Systems Engineering Management Plan **shall** document the reporting mechanism to the government of requirements tracing to all levels.

The Systems Engineering Management Plan **shall** describe the format planned and tools to be used for documenting and tracking the requirements.

The Systems Engineering Management Plan **shall** define when requirements identification is due and when formal configuration control is expected to start.

The Systems Engineering Management Plan **shall** describe what tools are planned to track verification status.

The Systems Engineering Management Plan **shall** list the resource budgets Systems Engineering will track, the margin philosophy, who will collect the inputs, how often they will be collected, and when allocation of the budgets are due and when they will be placed under formal configuration management.

The Systems Engineering Management Plan **shall** define the role of systems engineering in risk management and how the systems engineering management plan and the risk management plan are related.

The Systems Engineering Management Plan **shall** define the reliability philosophy and what reliability analyses are planned, who is responsible and how the analyses are to be accomplished, including any special tools.

The Systems Engineering Management Plan **shall** define when and how often reliability analyses are to be performed.

The Systems Engineering Management Plan **shall** define which system engineering reviews are planned.

The Systems Engineering Management Plan **shall** define what systems engineering documentation is planned and when it is to be placed under formal configuration management.

The Systems Engineering Management Plan **shall** describe the method to archive and distribute System Engineering information generated during the course of the lifecycle.

The Systems Engineering Management Plan **shall** Define the Systems Engineering Organization Chart and Job Responsibilities.

The Systems Engineering Management Plan **shall** include a top-level schedule for the system engineering activities including major work previously identified.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: SE-02

2. Title: System Requirements Specification

3. Use:

The System Requirements Specification assures that the contractor is performing in accordance with the contractual and government Level III requirements.

4. Preparation Information:

The System Requirements Specification **shall** define the contractor's software and hardware requirements for the spacecraft and Ground Support Equipment in order to assure that the contractor is performing in accordance with the contractual and government Level III requirements.

The System Requirements Specification **shall** include derived requirements from GOES-R Spacecraft Functional and Performance Specification, the GOES-R GIRD, the Instrument UIIDs, the Spacecraft MAR, and the SOW.

The lower level Spacecraft Design Specification and Subsystem level specifications **shall** be directed and controlled by the System Requirements Specification.

The GOES-R System Requirements Specification **shall** be delivered in a DOORS compatible format.

The GOES-R System Requirements Specification **shall** include a Requirements Traceability Matrix that includes:

1) An impacts field identifying all systems and subsystems that may be affected by a proposed change to this requirement.

2) An interface impacts field identifying all systems and subsystems that may be affected by a proposed change to this requirement due to an interface association.

3) Identification of the parent requirement.

The content of the Spacecraft Requirements Specification should be in accordance with MIL-STD-490, or the contractor equivalent format.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: **2. Title:**

SE-03 Spacecraft Detailed Design Specification

3. Use:

The Spacecraft Detailed Design Specification delineates the contractors design for the GOES-R Spacecraft. It establishes the top level design and interface specification(s) placed on the Spacecraft.

4. Preparation Information:

The Spacecraft Detailed Design Specification **shall** provide the hardware and software specifications to be used by the contractor to direct the development of the Instrument and ground support equipment.

The Spacecraft Detailed Design Specification **shall** consist of separate specifications as appropriate.

The Spacecraft Detailed Design Specification **shall** include engineering requirements down to the subassembly level and as needed to the part level.

The Spacecraft Detailed Design Specification **shall** include interface requirements internal and external to spacecraft. (Separate Interface Requirements Specifications should be used where appropriate.)

The Spacecraft Detailed Design Specification **shall** include operational parameters and requirements.

The Spacecraft Detailed Design Specification **shall** include safety and assurance requirements.

The Spacecraft Detailed Design Specification **shall** include software requirements to the component level.

The Spacecraft Detailed Design Specification **shall** include unique identifiers for each requirement.

The Spacecraft Detailed Design Specification **shall** include traceability matrices identifying parent requirements and any requirements impacted by a change in the requirement.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: SE-04

2. Title: System Performance Verification Plan

3. Use:

Provides a description of the spacecraft performance and verification test program, and describes the specific tests and/or analysis, calibrations, alignments, etc. that will collectively demonstrate that the hardware/software complies with the system performance and environmental requirements.

4. Preparation Information:

The System Performance Verification Plan **shall** describe the approach (e.g. test, analysis) that will be used to verify the hardware/software complies with system requirements.

The System Performance Verification Plan **shall** address the environmental verification program either as a separate section or as a separate stand alone document.

The environmental verification section of the System Performance Verification Plan **shall** describe the contractor's approach for qualification and acceptance testing. It is intended to provide general test philosophy and an overview of the system-level environmental testing to be performed to demonstrate adequacy of the spacecraft for flight, (e.g., vibration, shock, thermal vacuum).

If performance or environmental verification is performed at level of assembly other than spacecraft, the System Performance Verification Plan **shall** describe the relationship of the test and analysis to spacecraft level verification.

The System Performance Verification Plan **shall** address any limitations in the ability to verify any performance or environmental requirement along with a risk assessment of the inability to verify the requirement.

Where requirements are verified by analysis, the System Performance Verification Plan **shall** include objectives, a description of the mathematical model, assumptions on which the models will be based, required output, criteria for assessing the acceptability of the results, the interaction with related test activity, if any, and requirements for reports.

The System Performance Verification Plan **shall** contain detailed test flow sequence charts showing sequence of development and spacecraft level testing, including integration and qualification/acceptance test activities for the spacecraft and spacecraft unit/component.

The System Performance Verification **shall** indicate in the test flows where Comprehensive and Limited Performance Tests will be conducted.

The System Performance Verification Plan **shall** provide descriptions of the tests and activities that will be performed at the spacecraft contractor's facility and at the launch site (descriptions include: level of assembly, configuration of item, objectives, facilities, instrumentation, safety consideration, contamination control, test phases and profile, necessary functional operations, personnel responsibilities, and requirements for procedures and reports).

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The System Performance Verification Plan **shall** include a description of when and how frequently all redundant parts and cross-strapped paths will be tested during each test activity.

The System Performance Verification Plan **shall** address the plan for the verification of all previously flown and qualified hardware, including identification of additional verification testing that is required.

The System Performance Verification Plan **shall** include a recommended post-launch test plan.

The System Performance Verification Plan **shall** provide a description of all ground support facilities and equipment planned along with plan for certification of any lifting equipment.

The System Performance Verification Plan **shall** include a description of the operational methodology for controlling documenting and approving activities not part of the approved test procedure

The System Performance Verification Plan **shall** address the controls to prevent accidents that could damage or contaminate hardware or facilities, or cause personal injury.

The System Performance Verification Plan **shall** address the controls for real-time decision-making mechanisms for continuation or suspension of testing after malfunction, and a method for determining retest requirements, including the assessment of the validity of previous tests.

The System Performance Verification Plan **shall** contain a Performance Verification Matrix that maps performance and design requirements/parameters against the test verification methods to prove compliance with the specification requirements.

The Performance Verification Matrix in the System Performance Verification Plan **shall** include columns of information to identify and/or describe the following minimum information:

1) Parameter description
2) Specification requirement
3) Method of compliance verification (test, life test, demonstration, analysis, inspection).
4) Level of Assembly where compliance will be verified (spacecraft, unit, assembly)
5) Identification of design phase and integration level at which verification is performed.
6) System Performance Verification Test Plan number
7) Test Procedure number or identifier
8) Test Report Number

The environmental verification section of the System Performance Verification Plan **shall** contain an Environmental Test Matrix compatible with the matrix in Figure 2.1-1 of the GSFC General Environmental Verification Specification.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: **2. Title:**

SE-05 Spacecraft to Instrument ICDs

3. Use:

This document is used to define the interfaces between the spacecraft and the GFP instruments. The purpose of the ICD is to communicate the specific details of all possible inputs and potential outputs between the Spacecraft and the GFP instruments. In this way, independent teams can develop the connecting systems which use the interface specified, without regard to how other systems will react to data and signals which are sent over the interface. For example, the ICD includes information about the size and format of the data, but not the *meaning* of the data, in the sense that the ICD describes how the recipient should react to received data.

4. Preparation Information:

A separate Spacecraft to Instrument ICD **shall** document each GFP Instrument interface.

The Spacecraft to Instrument ICDs **shall**

1) Include requirements from the Instrument Description Documents (IDDs) provided by the GFP Instrument contractors.
2) Specify the GFP Instrument mechanical, electrical, thermal, contamination, command and data handling interfaces with the spacecraft
3) Specify the GFP Instrument to Spacecraft integration and test requirements
4) Specify the Spacecraft GSE to GFP Instrument GSE interface for all GSE components

The Spacecraft to Instrument ICDs' revisions **shall** provide updated interface environments when more accurate data is available.

The Spacecraft to Instrument ICDs **shall** contain the following:

1) A title page including the specification number, date, title and approval certifications.
    a. The title **shall** include nomenclature of both interfacing systems
    b. Approval certifications **shall** provision for office title, signatory name, signature and approval date
2) Scope. The scope **shall** include:
    a. System/segment interface identification. This section **shall** briefly describe the overall system, segment, or equipment to be addressed by the interface specification. It **shall** include a matrix diagram identifying each interfacing item, and show the origin and destination of each interface.
    b. Documentation organization. This section **shall** describe the manner in which the specification is structured, and provides guidance on its use.
    c. Limitations and restrictions. This section **shall** describe any limitations or restrictions to the use of the specification.
3) Applicable documents. All documents having a bearing on the system and segment interfaces **shall** be identified in sub-sections by the title, number, and applicable data. This **shall** include:
    a. Government specifications, standards, and handbooks.

   b. Interface control documentation. This includes all related of referenced interface control drawings and interface control specifications.
   c. Other documentation. This includes any applicable industry or other documentation.
4) Interface requirements. This section provides the detailed description of the interface requirements. Each interface **shall** be separately covered in its own subsection, and include:
   a. Interface identification and description
   b. Functional interface specification details by parameter.
   c. Physical interface specification details by parameter.
   d. Environmental details by parameter.
5) Quality assurance. This section **shall** identify and define the inspection and test requirements necessary to verify the designed end product complies with the interface requirements of the interface requirements.

In the Spacecraft to Instrument ICDs, the functional interface specification details by parameter **shall** include:

1) For electronics, requirements with related tolerances **shall** include: signal characteristics, wave forms, voltage, frequencies, shielding requirements, circuit impedance, current limits and current requirements.
2) For power, requirements with related tolerances **shall** include: type of power (AC or DC), frequency characteristics, voltage levels, power ratings (amperes, watts, volt-ampere), wave forms, grounding.
3) Optical/electro-optical requirements.
4) Human factors and engineering requirements.

In the Spacecraft to Instrument ICDs, the physical interface specification details by parameter relating the physical mating of the two systems at a common boundary **shall** include:

1) Reproductions of or references to the applicable interface control drawings and installation drawings.
2) Dimensions and tolerances of mating surfaces with applicable sizes, shapes, and spacing including flanges, bolt holes, and mounting plates.
3) Weight, balance, and center of gravity.
4) Materials specifications including dissimilar material requirements.
5) Cabling requirements including connectors and routing.
6) Applied loads.
7) Accessibility including installation and removal clearance.
8) Sealing requirements, leakage prevention and detection.

In the Spacecraft to Instrument ICDs, the environmental details by parameter **shall** include:

1) Electromagnetic interfaces, compatibility requirements.
2) Vibration envelopes including sine and random
3) Shock limits.
4) Acceleration limits.
5) Acoustic sound pressure limits.
6) Temperature limits.
7) Noise factors.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SE-06	Spacecraft to STDN / DSN ICD

3. Use:

The Spacecraft to STDN / DSN ICD documents the details of this interface and provides a reference analysis of the RF ranging performance through STDN / DSN ground stations and/or through any other ranging service provided the contractor has chosen to use during launch and orbit raising, and during normal operations.

4. Preparation Information:

The Spacecraft to STDN / DSN ICD **shall** contain the following information as a minimum:

1) Up and down link budgets showing that the ranging requirements will be met, both with and without simultaneous command and telemetry signals also modulated onto the ranging carrier.

2) Analysis and measurement results showing compliance with all NTIA and ITU requirements.

3) Predictions of parameters to be measured at system level testing, including Spacecraft Thermal Vacuum (SCTV).

4) Trade-space descriptions and analysis of the trade-off proposed/chosen for each of the options allowed by JPL document 810-005 or other reference documents.

5) Measured performance parameters taken during system level testing, including SCTV, provided and compared to the predicted values.

All issues of the Spacecraft to STDN / DSN ICD **shall** be in a standard electronic format.

The final copy of the Spacecraft to STDN / DSN ICD **shall** contain measured values.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: **2. Title:**

SE-07 Spacecraft Communications Services ICDs

3. Use:

The Spacecraft Communications Services ICDs document the details of these interfaces and provide a reference analysis of the RF performance. The interface supports the communication of data between the Space Segment and the ground. Consequently, these Interface Control Documents (ICD):

1) Identify the required communication links from the spacecraft to the ground

2) Establishes functional and performance requirements related to these communication links.

The communication link interfaces between the GOES-R spacecraft and the communication services are described in the Interface requirements Documents listed in Block 4. Preparation Information, below:

4. Preparation Information:

The Spacecraft Communications Services ICD **shall** address the requirements found in the associated Interface Requirements Documents IRDs:

1) 417-R-IRD-0001, RM Version, GOES-R Series, Space Segment (SS) to Ground Located -Command, Control, and Communications Segment (GL-C3S) Interface Requirements Document (IRD)

2) 417-R-IRD-0002, RM Version, GOES R Series Space Segment (SS) to Ground Rebroadcast (GRB) Service Interface Requirements Document (IRD)

3) 417-R-IRD-0003, RM Version, GOES-R Series, Space Segment (SS) to Low Rate Information Transmission (LRIT) Service Interface Requirements Document (IRD)

4) 417-R-IRD-0004, RM Version, GOES-R Series, Space Segment (SS) to Emergency Managers Weather Information Network (EMWIN) Interface Requirements Document (IRD)

5) 417 R-IRD-0005, RM Version GOES-R Series, Space Segment (SS) to Data Collection System (DCS) Interface Requirements Document (IRD)

6) 417-R-IRD-0006, RM Version, GOES-R Series, Space Segment (SS) to Search and Rescue (SAR) Service Interface Requirements Document (IRD)

The Spacecraft Communications Services ICD **shall** address the requirements found in the associated IRDs.

The Spacecraft Communications Services ICDs **shall** contain the following information as a minimum:

1) Up and down link budgets showing that the ranging requirements will be met, both with and without simultaneous command and telemetry signals also modulated onto the ranging carrier.

2) Analysis and measurement results showing compliance with all NTIA and ITU requirements.

3) Predictions of parameters to be measured at system level testing, including SCTV.

4) Measured performance parameters taken during system level testing, including SCTV, provided and compared to the predicted values.

All issues of the Spacecraft Communications Services ICDs **shall** be provided in a standard electronic format.

The final copy of the Spacecraft Communications Services ICDs **shall** contain measured values.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: **2. Title:**

SE-08 Telemetry and Command Performance Analysis Report

3. Use:

The Telemetry and Command Performance Analysis Report provides the analyses and data required to demonstrate the GOES R T & C subsystem meets all the RF performance requirements.

4. Preparation Information:

The Telemetry and Command Performance Analysis Report shall include the following:

1) Each test signal path measurement error budget **shall** be calculated.

2) An automated test equipment block diagram showing the test signal paths between test components, switches, attenuators, gain and mixer stages **shall** be provided.

The Telemetry and Command Performance Analysis Report **shall** consist of a series of technical memos, each written throughout the development of the GOES-R series.

The Telemetry and Command Performance Analysis Report **shall** describe and present, in detail, the predicted performance of the spacecraft T &C Subsystem.

The Telemetry and Command Performance Analysis Report **shall** contain, as a minimum, narrative, model data and analysis, where appropriate, addressing the following subjects as they pertain to the On-orbit and orbit raising T & C Subsystem functions.

The Telemetry and Command Performance Analysis Report **shall** contain the following Radio Frequency Sections and Coverage:

1) Center frequency, signal path gain distribution, dynamic range, RF bandwidth, G/T, channel isolation, overload protection, AGC performance, phase linearity, gain flatness, carrier phase noise, AM/AM and AM/PM conversion, spurious PM, incidental AM, EIRP, axial ratio, C/N, spurious outputs, frequency stability, noise figure, time delay, active and passive intermodulation and BER.

2) The following technical performance parameters of the GOES R, T & C subsystem RF telemetry and command function hardware, including gain, loss, bandwidth, noise temperature, amplifier power, and EIRP **shall** be presented in tabular form. The gain/loss tabulation **shall** include as a minimum each connector, waveguide section, flange VSWR, diplexer loss, switch loss, SIT pads, amplifier gain and power, amplifier backoff, transmit and receive antenna gains, EIRP, pre-amp gain, VSWR effects and pre-amp and transponder noise temperature calculation. The document **shall** provide separately the tolerance of each channel or service parameter, and BOL/EOL margins **shall** be shown. The tabulated data **shall** also be delivered in Excel spreadsheet compatible files with the applicable formulas.

3) Operating modes and configurations.

4) Analyze the frequency and channelization plan and provide analyses determining self-interference, mutual interference, cross channel interference, filter and isolation requirements with the on-orbit and transfer

orbit antennas field of view predictions.

5) Bus power consumption and inrush current.

6) Transfer orbit and On-orbit coverage, antenna component measurement data, and link margin predictions.

7) Spacecraft position and attitude prediction data of orbit raising activity.

T & C Automated Test Equipment Testing

The Telemetry and Command Performance Analysis Report **shall** describe and present in detail the performance of each T & C Subsystem verification and compatibility test method and the hardware and software implementation.

The Telemetry and Command Performance Analysis Report **shall** contain, as a minimum, narrative, software verification test data and analysis, addressing each verification test.

1) Analysis efforts **shall** include showing that each signal path used for each measurement has proper bandwidth, power levels, and signal-to-noise ratios at each sensors most accurate range of measurement. The calibration error budget **shall** be determined and a measurement accuracy analysis completed.

2) The contractor **shall** provide GOES R Spacecraft T & C Subsystem ATE equipment hardware drawings that describe and present in detail the component interconnections, signal routing paths, and command, control, and data acquisition interfaces. These drawings **shall** document both the electrical and mechanical configurations and include the complete signal pathways to the spacecraft T & C subsystem.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SE-09	Satellite Data Format Control Book Handbook

3. Use:

The Satellite Data Format Control Book (DFCB) is a comprehensive cross referenced compilation of all telemetry and command data needed for all spacecraft component, instrument, and payload operation. This document provides information to identify and extract all source packets and their contents sent to or received from the spacecraft. It will be used to guide the design, development, testing, and operation of the GOES-R Ground Segment mission management capabilities.

4. Preparation Information:

The DFCB **shall** contain detailed primary header, secondary header including user defined flags, and data zone format definitions for all telemetry and command packets.

If CRCs are used, their computational algorithms **shall** be listed.

Telemetry List
The Telemetry List **shall** contain all telemetry items, their descriptions, APIDs and other identifiers, coefficients where appropriate, and additional user data listed in the spacecraft and instrument T&C Handbooks.

Command List
The Command List **shall** contain all command items, their descriptions, APIDs and other identifiers, criticality, and additional user data listed in the spacecraft and instrument T&C Handbooks.

Telemetry and Command Cross Reference
The DFCB **shall** contain listings of all spacecraft and instrument commands and the telemetry points they affect. Two versions of this list **shall** be generated. The first **shall** be a listing by APID and command identifier if used and the second a listing by APID and telemetry identifier if used.

ST&C Handbook Publication
Each release of the ST&C Handbook **shall** be delivered electronically and via hard copy.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: **2. Title:**

SE-10 **Command Encryptor M & O Manual and Interface Description Document**

3. Use:

Enable the Government to review command encryption operation and maintenance and to familiarize students attending command link encryption training for maintenance and operation.

Enable the Government to implement the interfaces required for the Command Encryptor.

4. Preparation Information:

1) Command Encryptor M & O Manual

A detailed operations and maintenance manual shall be provided for the Encryptor units.

The M & O Manual shall be prepared in accordance with NESS Standard S24.801, "Preparation of Operations and Maintenance Manuals", revised 07/15/92. ** *to be confirmed***

2) Command Encryptor Interface Description

The contractor shall provide a detailed description of all command Encryptor interfaces with the NOAA ground system.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SE-11	Satellite Level Instrument Interface INR Analysis Plan

3. Use:

The approach here is that the spacecraft contractor will perform analyses and tests and provide the data required for interface performance assessment and for INR ground processing and performance assessment. The data will be provided to instrument contractors to verify that the physical and data interfaces with the spacecraft comply with specifications. The data will be provided to an operations-ready or prototype version of the ground processing system so that the ground and instrument contractors can jointly verify that INR performance meets requirements.

This CDRL documents the analysis plan.

4. Preparation Information:

The Satellite Level Instrument Interface INR Analysis Plan **shall** be segregated into the following two sections:

1) Analysis for Nadir Pointed Instruments
2) Analysis for Solar Pointed Instruments

The Satellite Level Instrument Interface INR Analysis Plan **shall** present clear descriptions of methods, algorithms, commercial or proprietary tools to be employed, and models.

The Satellite Level Instrument Interface INR Analysis Plan **shall** present frequency cut-off criteria and damping ratios to be employed for various bus or component flexible body modes.

The Satellite Level Instrument Interface INR Analysis Plan **shall** describe how the articulating nature of the solar array is captured in the model.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: SE-12

2. Title: Satellite Level Instrument Interface INR Analysis Report and Data

3. Use:

The approach here is that the spacecraft contractor will perform analyses and tests and provide the data required for interface performance assessment and for INR ground processing and performance assessment. The data will be provided to instrument contractors to verify that the physical and data interfaces with the spacecraft comply with specifications. The data will be provided to an operations-ready or prototype version of the ground processing system so that the ground and instrument contractors can jointly verify that INR performance meets requirements.

This CDRL documents the analysis report and data.

4. Preparation Information:

Satellite Level Instrument Interface INR Analysis Report and Data **shall** be segregated into the following two sections:

1) Analysis for Nadir Pointed Instruments
2) Analysis for Solar Pointed Instruments

Satellite Level Instrument Interface INR Analysis Report and Data **shall** present the spacecraft to instrument interface performance for normal on-orbit, momentum unloading, stationkeeping, yaw flip, eclipse, post-eclipse, and all other periods not covered by the itemized list thus presented.

Satellite Level Instrument Interface INR Analysis Report and Data **shall** present results to demonstrate the effects of sun declinations.

Satellite Level Instrument Interface INR Analysis Report and Data **shall** contain spacecraft to instrument interface budgets and flow down allocations for all known spacecraft interface errors.

Satellite Level Instrument Interface INR Analysis Report and Data **shall** present the rationale to combine the individual error allocations into successive allocation levels up to the overall performance requirement of the specification.

Satellite Level Instrument Interface INR Analysis Report and Data **shall** present results indicating the effects of articulating, flexible dynamics the solar array on the pointing stability on the Sun-pointing instruments.

Satellite Level Instrument Interface INR Analysis Report and Data **shall** include error allocations for disturbance sources listed below, along with their categorization as static, diurnal or dynamic, with frequency content provided.

1) Orbit determination errors
2) Attitude determination errors
3) Bus jitter and sun-pointing attitude stability, in the presence of the disturbances and jitter due to solar array articulation
4) Instrument induced disturbances (e.g., instrument scanning, black body calibrations)
5) Uncompensated dynamic interactions
6) Errors in the estimation of the various compensation signals (e.g., curve fit error for rapidly changing thermal induced errors)
7) Thermally induced repeatable and non-repeatable errors (thermal models, mapping methods and software to be delivered for these cases)

8) GN&C maneuvers and impacts to instrument interfaces

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	2. Title:
SE-13	Satellite Level Instrument Interface INR Test Plan

3. Use:

The approach here is that the spacecraft contractor will perform analyses and tests and provide the data required for interface performance assessment and for INR ground processing and performance assessment. The data will be provided to instrument contractors to verify that the physical and data interfaces with the spacecraft comply with specifications. The data will be provided to an operations-ready or prototype version of the ground processing system so that the ground and instrument contractors can jointly verify that INR performance meets requirements.

This CDRL documents the test plan.

4. Preparation Information:

The Satellite Level Instrument Interface INR Test Plan **shall** be segregated into the following two sections:

1) Tests for Nadir Pointed Instruments
2) Tests for Solar Pointed Instruments

The Satellite Level Instrument Interface INR Test Plan **shall** be developed in cooperation between spacecraft and instrument contractors.

The Satellite Level Instrument Interface INR Test Plan **shall** identify the satellite-level tests necessary to demonstrate compliance with instrument to spacecraft interface requirements.

The Satellite Level Instrument Interface INR Test Plan **shall** identify the duration of the tests, data formats, and the spacecraft/instrument contractor support needed for conducting the tests.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SE-14	Satellite Level Instrument Interface INR Test Report and Data

3. Use:

The approach here is that the spacecraft contractor will perform analyses and tests and provide the data required for interface performance assessment and for INR ground processing and performance assessment. The data will be provided to instrument contractors to verify that the physical and data interfaces with the spacecraft comply with specifications. The data will be provided to an operations-ready or prototype version of the ground processing system so that the ground and instrument contractors can jointly verify that INR performance meets requirements.

This CDRL documents the test report and data.

4. Preparation Information:

The Satellite Level Instrument Interface INR Test Report and Data **shall** be segregated into the following two sections:

1) Tests for Nadir Pointed Instruments
2) Tests for Solar Pointed Instruments

The Satellite Level Instrument Interface INR Test Report and Data **shall** contain the results of tests to demonstrate compliance with instrument to spacecraft interface translational acceleration requirements.

The Satellite Level Instrument Interface INR Test Report and Data **shall** contain the results of tests to determine actual performance of all interfaces affecting nadir pointed instrument INR performance.

The Satellite Level Instrument Interface INR Test Report and Data **shall** contain the results of tests to determine actual performance of all interfaces affecting sun pointed instrument accuracy and stability.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: SE-15

2. Title: Schematics Block Diagrams

3. Use:

To provide electrical schematic diagrams of all the spacecraft hardware, circuitry, and functions, including harness interfaces and test equipment interfaces. These diagrams will be used during spacecraft integration & test, and orbital operation for problem tracing, anomaly resolution, and procedure review.

4. Preparation Information:

The Schematics Block Diagrams should be presented in small but readable size format. The document should contain as many sheets as needed to ensure that every spacecraft +GFP interface functions are documented. The document should group the schematic diagrams by subsystems or functions for ease of circuit traceability.

The Schematics Block Diagrams may be in the contractor's format, except as noted in this DID.

Electrical Schematic block diagrams, as a minimum, **shall** include:

1) Overall system block diagrams, showing all the spacecraft subsystems, including all the GFP instrument interface signals

2) Detailed electrical diagrams, showing each spacecraft function such as power, command, telemetry, relay switching, pyrotechnic circuits, etc, and their harness interfaces. These diagrams should contain the as-built input and output circuits of all harness interfaces. These diagrams should show all the GFP instrument/Spacecraft interface circuits and harnesses. The diagrams of the Test equipment to spacecraft electrical interfaces should also be documented.

3) The harness interface of these detailed schematic diagrams should show the as-built harness configuration (wire gauge, twisted, shielding, etc). The electrical redundancy and cross-trapping of all the spacecraft units should be provided in these schematic diagrams.

4) System level grounding diagram, including isolation resistance between all ground returns and a description of all interconnecting power returns, telemetry returns, signal returns, shielding terminations, and chassis grounds for each piece of equipment and for each instrument. The diagrams **shall** include all interfaces to test equipment connected to the spacecraft when the spacecraft is powered on.

5) The reduced size schematics and block diagrams **shall** be provided in a three-ring notebook(s), and **shall** be clearly legible.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: SE-16

2. Title: Contamination Control Plan

3. Use:

To provide a contamination control plan that defines the necessary levels of cleanliness and defines the methods and procedures to be followed to achieve adequate cleanliness and contamination control for the spacecraft with respect to the instrument performance requirements.

To define the approach required to maintain cleanliness and contamination control during shipping, spacecraft integration and test, storage, shipping, launch site processing, launch, ascent, and through End of Life.

4. Preparation Information:

As a minimum, the Contamination Control Plan **shall** include the following in relation to the Spacecraft and Mission Performance Specification:

1) Define the beginning of life and end-of-life (EOL) contamination control requirements for all surfaces that affect instrument or spacecraft performance. Provide a contamination budget delineating the performance degradation for particulate (ground based and on-orbit contributions) and molecular (ground based non-volatile residue and on-orbit outgassing) contaminants as a function of development phase of the spacecraft through EOL.

2) Determine the effect of on-orbit outgassing on the spacecraft and instrument thermal and optical performance. All sources that have a line of sight from direct or return flux **shall** be considered. This includes, but is not limited to, the following: solar array(s) interior and exterior materials, the spacecraft panel surfaces, all appendages, spacecraft MLI, and venting from the internal spacecraft. The analyses **shall** be conducted using approved software programs to determine depositions on sensitive surfaces, and provide a particulate analysis that predicts redistribution during launch, ascent and on-orbit mission phases. The analyses **shall** include launch vehicle (LV) contribution to the S/C. All analyses **shall** include: theory assumptions, results of all runs/cases, geometric models, view factors, sticking coefficients, temperature defined outgassing rates, and accumulations.

3) Identify all flight hardware items to be vacuum baked and certified in order to achieve the overall instrument/spacecraft performance and molecular cleanliness requirements, as impacted from hardware and spacecraft outgassing. Provide the bakeout parameters for configuration of the spacecraft, temperature for bakeout and certification, chamber pressure requirements, location of outgassing monitoring sensors such temperature-controlled quartz crystal microbalances (TQCMs) or equivalent, and acceptable monitored rates of outgassing for the chamber and for the spacecraft.

4) Define the contamination mitigation aspects of the design (e.g. material selection, vent design and orientation, baffles, decontamination heaters). Include the verification methodology necessary for achieving the contamination budgets. Describe the techniques for verifying surface cleanliness levels and material outgassing rates.

5) Ascertain that materials used in spacecraft hardware design conform to the outgassing screening criteria provided by NASA Reference Publication 1124, entitled, “Outgassing Data for Selecting Spacecraft Materials”. This publication is intended to be used as guidelines for initially screening materials, and it is

not intended to be used as pass/fail criteria. Non-conformance's to the screening criteria **shall** be submitted for approval through a system consistent with the spacecraft contractor's Product Assurance Plan for a material's deviation to these material selection criteria. Materials used in close proximity to critical optics or sensitive thermal control surfaces may require more stringent outgassing requirements and/or limitations on material quantity. The more stringent requirements will be established according to instrument or thermal performance requirements and modeled as noted in 2) above.

6) Define the requirements and the methods and procedures required to maintain cleanliness during spacecraft integration and test and launch site processing. The requirements **shall** be based upon the most sensitive affected system, any GSP or LV hardware which comes in contact with the spacecraft **shall** meet the requirements of that flight hardware, including instruments.

7) Identify the environmental facility parameters necessary for fabrication, assembly, I & T, and launch operations of the spacecraft. As a minimum, the parameters **shall** include airborne particulate room classification, relative humidity, temperature, fallout rates, non-volatile residue (NVR) accumulation, hydrocarbon levels, and garment requirements

8) Provide all cleaning, inspection, and bagging plans/procedures necessary for ground support equipment, interface hardware, and flight hardware for all assemblies during all phases. Provide in the contamination control plan a section for instrument covers or a plan that describes when covers for contamination sensitive instruments are installed or removed through the I&T flow; how the covers removed from the instruments are stored, and the process for removal at launch base prior to encapsulation, and how the removal or installation process is recorded.

9) Provide an assessment and methodologies for maintaining and verifying cleanliness during transportation and storage periods of the spacecraft.

10) Provide an operation flow chart that identifies when all planned cleanliness inspections, spacecraft bagging, and cleanings will occur from manufacture through launch site processing.

11) Describe the methods by which cleanliness requirements are flowed down to the subcontractors and how the subcontractor hardware will be inspected/tested to ensure compliance to all cleanliness requirements.

12) Provide a spacecraft specific contamination control training program for all personnel required to work on flight hardware in clean rooms, clean areas, or on clean benches.

13) Include a monitoring plan for the spacecraft and integrated exposed instrument surface cleanliness and outgassing requirements for fabrication, assembly, integration & test, spacecraft ground processing and launch site activities (including fairing encapsulation). For on-orbit EOL, provide analyses that demonstrate performance/ cleanliness requirements are met. The monitoring plan **shall** describe reporting of contamination levels during the integration and test phase through launch site activities (up to encapsulation and fairing monitoring efforts).

14) Provide a purge plan that details the design and construction of a portable purge cart that will provide a two-stage stepdown of a high pressure purge source for all instruments delivered to the spacecraft that require GN2 purge. The plan **shall** include description of all components required to satisfy the design and safety requirements for a high purity delivery system, including but not limited to regulators, valves, tubing, fittings, flowmeters, pressure relief devices, purifiers, filters, and the purge lines from the purge cart to the instrument or spacecraft purge interface. The plan **shall** also describe the purge line cleanliness

procedures and verification methodologies.

15) The purge gas for all spacecraft operations **shall** be high-purity gaseous nitrogen (GN2) conforming to the MIL-STD-27401 Grade B, Type I requirements for total hydrocarbons (THC) and moisture. In lieu of GN2, manufactured air (zero grade) may be used if zero-grade air does not degrade the system or is required due to safety constraints with respect to the use of GN2 purge systems. In addition to meeting MIL-STD-27401 purity requirements, the purge delivery system **shall** also incorporate a 0.5µm particulate filter for in-line use with the purge system located at the output of the purge line on the cart. Verification of these requirements is required for all purge sources as sampled from point of use. Documentation of the cleanliness/purity **shall** be provided to the contamination engineer prior to purge connection/use. A purge gas methodology **shall** be provided for the entire spacecraft flow from instrument integration through launch operations.

16) Provide a plume analyses from station-keeping maneuvers or orbit transfers. The analysis **shall** assess any potential degradation to the spacecraft and instrument thermal and optical performance requirements. Consider LV retrorockets and thruster exhaust plume impact on the spacecraft.

17) Define any launch or on-orbit constraints necessary to satisfy instrument and spacecraft contamination requirements.

18) For the proposal, provide an approach to the purge system and fairing cleanliness impact to the spacecraft and instrument requirements. The approach **shall** include all purge logistics at the launch site and fairing surface cleanliness, verification, and monitoring relative to spacecraft design differences.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SE-17	Spacecraft Contamination Model and Report

3. Use:

The Spacecraft Contamination Model and Report will be used to verify:

- the basic spacecraft design minimizes contamination risk to instruments and predict contamination-induced performance degradation of the spacecraft bus surfaces
- recommend design modifications if performance problems are found

This model will be used to provide the instrument teams with expected contamination fluxes into their instrument apertures, and to verify compliance with flu requirements in the GIRD. This model will be used to optimize vent locations and aid in defining required out-gassing rates for thermal vacuum bake-out.

4. Preparation Information:

The Spacecraft Contamination Model and Report **shall** use the following codes, or codes that demonstrably have comparable fidelity, TRASYS code for the geometrical model and view factors, SPACE II for direct flux calculations, and MOLFLUX for return flux.

In the Spacecraft Contamination Model and Report, the input files, source codes and output files **shall** be available on magnetic tape or disk.

As a minimum, the Spacecraft Contamination Model and Report **shall** include the following contamination inputs: vents, thruster firings and out-gassing from materials and components.

The Spacecraft Contamination Model and Report **shall** include:

1) Analysis verifying compliance with on-orbit fluxes into instrument apertures requirements of the GIRD including time dependencies of said fluxes and assumptions that went into the calculations.

2) Provide the total mission flux over 6 years.

3) Calculations of performance degradation of spacecraft components due to contamination fluxes and deposition onto spacecraft surfaces. Include all assumption involve with this calculation.

4) Provide plots of the geometrical model form several views so that all contamination sources and contamination –sensitive surfaces used in the model can be seen. Identify the vent and thruster locations on the plots.

5) For each vent provide the equations and set of data or assumption used in the model to describe the flow rate and direction of the vent effluent.

6) Identify the types and “sizes” (i.e. thrust levels) of thrusters used in the model. For each thruster type and size, provide the equation or set of data that was used in the model to describe the thruster plume. Include the “backflow region”, i.e. angles greater than 90 degrees from plume centerline. For each thruster type

and size, identify the molecular species emitted by the thruster and give the mole fraction of each species present. Describe the thruster firing sequenced used in the model, e.g. how many, burn time.

7) Provide a list of out-gassing sources (materials or components) used as inputs to the model, including out-gassing rate, time dependence of rate and support information on rate chosen.

8) Identify the species of molecular contaminants used in the model and justify why these species were chosen.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SE-18	Electrostatic Discharge (ESD) Prevention Plan

3. Use:

The Electrostatic Discharge (ESD) Prevention Plan will be used to evaluate the proposed design to ensure that data product outages due to ESD events are minimized.

4. Preparation Information:

The Electrostatic Discharge (ESD) Prevention Plan **shall** describe the planned design features that will be used to minimize the occurrence of ESD events in orbit.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SE-19	Single Event Upsets (SEU) Prevention Plan

3. Use:

To evaluate the proposed design to ensure that data product outages due to Single Event Effects are minimized.

4. Preparation Information:

The SEU Prevention Plan **shall** describe the planned design features that will be used to minimize the occurrence of Single Event Effects during satellite transfer orbit and synchronous orbit operations, and to describe the fault detection and correction methodology following single events.

The SEU Prevention Plan **shall** include the following minimal material.

1) Description of threat analysis to include how/where charge build up and magnitude/duration of transient.

2) Description of damage/upset threshold analysis for outboard electronics.

3) Description of protection devices to be used to attenuate ESD transients to levels equal to or below the damage threshold.

4) Description of grounding scheme and shielding topology used to mitigate ESD events.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: SE-20

2. Title: Radiation Shielding and Dose Analysis Report

3. Use:

Provide a radiation and shielding analysis to ensure that all spacecraft components/parts on box-to-box basis will be compatible with the expected space radiation environment for the required mission life as defined in "The Radiation Environmental for Electronic Devices on GOES-R Series Satellites", 417-R-0027, August, 2006.

4. Preparation Information:

The Radiation and Shielding and Dose Analysis Report **shall** include a description of the model used to generate radiation dose predictions, including:

1) Description of the shielding analysis software.
2) Description of the satellite shield geometry and composition, as modeled.
3) List of assumptions and approximations.
4) Estimate of model prediction accuracy.

The Radiation and Shielding and Dose Analysis Report **shall** include a tabular listing of predicted ionizing dose at end-of-spacecraft life for each spacecraft unit.

The Radiation and Shielding and Dose Analysis Report **shall** define the proposed parts that will require additional shielding to be compatible with the required spacecraft mission life.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
MA-01	Mission Assurance Implementation Plan

3. Use:

To define the contractor's systematic approach to, and processes used in, the management, development, testing (verification, validation, and qualification), documentation, configuration management, and quality assurance of the Spaceflight Hardware, Software and Ground test equipment.

The following reference this DID:

- Mission Assurance Requirements 417-R-SCMAR-0011
- SCMAR 3

4. Preparation Information:

The Mission Assurance Implementation Plan **shall** address all applicable requirements of relevant quality standard (Q9001). Refer to ISO 10013 Quality Manual Development Guide for further guidelines on preparation of a Mission Assurance Implementation Plan.

The Mission Assurance Implementation Plan Manual **shall** contain:

1) The title, approval page, scope and the field of application;
2) Table of contents;
3) Introductory pages about the organization concerned and the manual itself;
4) The quality policy and objectives of the organization;
5) The description of the organization, responsibilities and authorities, including the organization responsible for the implementation of al sections of the Mission Assurance Requirements 417-R-Mar 0011 including EEE parts, materials, reliability, safety, assembly and test requirements
6) A description of the elements of the quality system, Contractor policy regarding each element and Contractor implementation procedure for each clause or reference(s) to approved quality system procedures; system level procedures **shall** address the implementation of all requirements cited in this document.
7) A definitions section, if appropriate;
8) An appendix for supportive data, if appropriate.

Mission Assurance Implementation Plan distribution and changes **shall** be implemented by a controlled process.

The Mission Assurance Implementation Plan **shall** be maintained and updated by the Contractor throughout the life of the contract.

Effective Date: (Date of last signature)

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
MA-02	As-Designed Parts List (ADPL)

3. Use:

Listing of all parts intended for use in space flight hardware: As-Designed Parts List (ADPL)

4. Preparation Information:

The ADPL **shall** document parts approved for designed hardware.

The ADPL **shall** be formatted in accordance with the requirements of the GOES-R Spacecraft Mission Assurance Requirements.

The ADPL **shall** follow the Parts Lists Required Fields Table below.

Effective Date: (Date of last signature)

Parts Lists Required Fields Table

FIELD	Required Field for Parts List Type		
	ADPL	**PAPL**	**ABPL**
Item Number	X	X	X
Spacecraft Name	X	X	X
Instrument Name	X	X	X
Generic Part Number	X	X	X
Procurement Part Number	X	X	X
Flight Part Number		X	X
Description	X	X	X
Package: Case Style and Number of Pins	X	X	X
Lot Date Code			X
Manufacturer	X	X	X
Cage Code	X	X	X
Distributor	X		
Additional Testing Required	X	X	
Quantity needed	X		X
Quantity Procured	X		
Radiation Hardness Evaluation: TID, Krads	X	X	X
Radiation Hardness Evaluation: SEL, MeV	X	X	X
Radiation Hardness Evaluation: SEU, MeV	X	X	X
Radiation Hardness Evaluation: Displacement Damage	X	X	X
Radiation Data Source: TID	X		
Radiation Data Source: SEE	X		
Notes	X		
PMCB Comments	X	X	
Approval Date	X	X	X
Box Identification	X	X	X
Part Location (Circuit Identifier)			X

Any format, preferably a spreadsheet, may be used provided the required information is included. All submissions to GSFC will include a

Effective Date: (Date of last signature)

paper copy and a computer readable form.
Updates to PIL, PAPL, ADPL, ABPL **shall** identify changes from the previous submission.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>

MA-03

2. <u>Title:</u>

As-Built Parts List (ABPL)

3. <u>Use:</u>

Listing of all parts intended for use in space flight hardware: As-Built Parts List (ABPL).

4. <u>Preparation Information:</u>

The ABPL **shall** be formatted in accordance with the requirements of the GOES-R Spacecraft Mission Assurance Requirements.

A separate ABPL **shall** be submitted for each assembly.

The ABPL **shall** follow the Parts Lists Required Fields Table below.

The ABPL **shall** provide a final compilation of all parts as installed in flight equipment, with additional "as-installed" part information such as manufacturer name, CAGE code, Lot-Date Code, part serial number (if applicable), quantity used and box or board location. The manufacturer's plant specific CAGE code is preferred, but if unknown, the supplier's general cage code is sufficient (See Parts List Required Fields Table below).

Effective Date: (Date of last signature)

Parts Lists Required Fields Table

FIELD	Required Field for Parts List Type		
	ADPL	PAPL	ABPL
Item Number	X	X	X
Spacecraft Name	X	X	X
Instrument Name	X	X	X
Generic Part Number	X	X	X
Procurement Part Number	X	X	X
Flight Part Number		X	X
Description	X	X	X
Package: Case Style and Number of Pins	X	X	X
Lot Date Code			X
Manufacturer	X	X	X
Cage Code	X	X	X
Distributor	X		
Additional Testing Required	X	X	
Quantity needed	X		X
Quantity Procured	X		
Radiation Hardness Evaluation: TID, Krads	X	X	X
Radiation Hardness Evaluation: SEL, MeV	X	X	X
Radiation Hardness Evaluation: SEU, MeV	X	X	X
Radiation Hardness Evaluation: Displacement Damage	X	X	X
Radiation Data Source: TID	X		
Radiation Data Source: SEE	X		
Notes	X		
PMCB Comments	X	X	
Approval Date	X	X	X
Box Identification	X	X	X
Part Location (Circuit Identifier)			X

Any format, preferably a spreadsheet, may be used provided the required information is included. All submissions to GSFC will include a

Effective Date: (Date of last signature)

paper copy and a computer readable form.
Updates to PIL, PAPL, ADPL, ABPL **shall** identify changes from the previous submission.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: MA-04

2. Title: Parts and Materials Control Plan

3. Use:

Description of developer's approach and methodology for implementing Parts Materials Control Program, including flow-down of applicable requirements to sub-developers.

4. Preparation Information:

The Parts and Materials Control Plan **shall** describe the contractor's plan or approach for conforming to Parts and Materials Program (PMP) requirements.

The Parts and Materials Control Plan **shall** describe the contractor's PMP control organization, identifying key individuals and specific responsibilities.

The Parts and Materials Control Plan **shall** provide detailed procedure for the Parts, Materials, Control Board (PMCB), to include PMCB membership, designation of Chairperson, responsibilities, review and approval procedures, meeting schedules and method of notification, meeting minutes, etc.

The Parts and Materials Control Plan **shall** describe PMP tracking methods and approach, including tools to be used such as databases, reports, NASA Parts Selection List (NPSL), etc. Describe system for identifying and tracking PMP approval status.

The Parts and Materials Control Plan **shall** describe PMP procurement, processing and testing methodology and strategies. Identify internal operating procedures to be used for incoming inspections, screening, qualification testing, derating, testing of PMP pulled from stores, Destructive Physical Analysis, radiation assessments, etc.

The Parts and Materials Control Plan **shall** describe PMP vendor surveillance and audit plan

The Parts and Materials Control Plan **shall** describe flow down of PMP requirements to sub-developers

The Parts and Materials Control Plan **shall** address the following for flight hardware threaded fasteners that are used in structural or critical applications:

- acquisition/supplier control
- documentation/traceability
- receiving inspection/testing

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
MA-05	Parts Control Program Plan

3. Use:

Description of developer's approach and methodology for implementing Parts Control Program (PCP) Plan, including flow-down of applicable PCP Plan requirements to sub-developers.

4. Preparation Information:

The PCP Plan **shall** be prepared and **shall** address all parts program requirements.

The PCP Plan **shall** include:

1) Parts Control Board (PCB) operating procedures, membership, responsibilities, authority, meeting schedules, Parts review procedures, Parts approval/disapproval procedures, GSFC involvement, and plans for updating the operating procedures; the definition of the role and authority of each PCB member; and relationships with various groups within the prime, associate, and sub-developer organizations (see section 11.2 for further information).

2) Shelf life control plan (see section 11.4.7.2 for further information).

3) Parts application derating (see section 11.4.4 for further information).

4) Part vendor surveillance and audit plan (see section 11.5.2 for further information).

5) Part qualification plan that describes how parts should be qualified for the intended end item application (see section 11.9 for further information).

6) Incoming inspection and test plan (see section 11.4.6 for further information).

7) Destructive Physical Analysis (DPA) plan (see section 11.4.7.1 for further information).

8) Defective parts controls program.

9) PCB coordination and interactions with other program control boards; i.e., CCB, and failure review board (FRB).

10) Radiation hardness assurance program plan as required (see section 11.6 for further information).

11) ESD control plan.

12) Corrosion prevention and control plan.

13) Contamination Prevention and Control Plan, as required.

14) Standardization of parts program .

15) Alternate Quality Conformance Inspection (QCI) and small lot sample plans, as required (see section 11.4.8

for further information).

16) Traceability control plan.

17) PCB **shall** develop, update and maintain a Project Approved Parts List (PAPL).

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
MA-06	Material Usage Agreement/Stress Corrosion Form

3. Use:

For usage evaluation and approval of non-compliant materials or lubrication usage.

4. Preparation Information:

A Materials Usage Agreement (MUA) **shall** be provided for each non-compliant off-the-shelf-hardware material usage, non-compliant polymeric material out gassing, flammability or toxicity usage and non-compliant inorganic material stress corrosion cracking usage.

The MUA **shall** provide as a minimum: material rating, usage agreement number, page number, drawing numbers, part or drawing name, assembly, material name and specification, manufacturer and trade name, use thickness, weight, exposed area, pressure, temperature, exposed media, application, rationale for safe and successful flight, originator's name, project manager's name and date. Table 1 of MSFC-STD-3029 Multi Program/Project Common-Use Document Guidelines for the Selection of Metallic Materials for Stress Corrosion Cracking Resistance in Sodium Chloride Environments Materials, Processes, and Manufacturing Department Metallic Materials and Processes Group lists examples of materials that can be considered for use.

The off-the-shelf-hardware usage in the MUA **shall** identify the measures to be used to ensure the acceptability of the hardware such as hermetic sealing, material changes to known compliant materials, vacuum bake-out to the error budget requirements listed in the contamination control plan.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
MA-07	As-Designed Materials and Lubrication List

3. Use:

Provides data on as-designed material usage.

4. Preparation Information:

The As-Designed Materials and Lubrication List **shall** document parts approved for designed hardware.

The As-Designed Materials and Lubrication List **shall** be in accordance with figures shown in the GOES-R Spacecraft Mission Assurance Requirements.

A separate As-Designed Materials and Lubrication List **shall** be submitted for each Instrument with reference to the assembly number.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: MA-08

2. Title: As-Built Materials and Lubrication List

3. Use:

Details the actual configuration of the delivered article(s). Provides data on as-built material usage.

4. Preparation Information:

The As-Built Materials and Lubrication List **shall** provide a final compilation of all materials and lubrication used in flight equipment, with additional information such as manufacturer name, CAGE code, quantity required and box or board location. The manufacturer's plant specific CAGE code is preferred, but if unknown, the supplier's general cage code is sufficient

The As-built Materials and Lubrication List **shall** be in accordance with figures shown in the GOES-R Spacecraft Mission Assurance Requirements.

A separate As-built Materials and Lubrication List **shall** be submitted for each Instrument with reference to the assembly number.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>**CDRL No.:**</u>	2. <u>**Title:**</u>
MA-09	Electrostatic Discharge Control Plan

3. <u>Use:</u>

Define the plan for minimizing ESD during assembly.

4. <u>Preparation Information:</u>

The Electrostatic Discharge Control (ESD) Plan **shall**:

1) Describe the scope of the ESD Program;

2) Describe the tasks, activities, and procedures necessary to protect ESD sensitive items at or above a specified sensitivity level;

3) Identify organizational responsibilities for the tasks and activities;

4) List directive or supportive documents used in the Project.

5) Include a listing of the specific type of ESD protective materials and equipment used in the Program. A major element in an effective Plan is the assessment of the ESD susceptibility of parts, assemblies and equipment and their required protection levels.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: **2. Title:**

MA-10 System Safety Program Plan

3. Use:

The approved System Safety Program Plan provides a formal basis of understanding between the Range User and Range Safety on how the System Safety Program will be conducted to meet the requirements of AFSPCMAN 91-710 and the NPR 8715.3 NASA Safety Manual, including general and specific provisions.

4. Preparation Information:

The approved System Safety Program Plan (SSPP) **shall** account for all contractually required tasks and responsibilities on an item-by-item basis.

The SSPP **shall** describe in detail the tasks and activities of system safety management and engineering required to identify, evaluate, and eliminate or control hazards by reducing the associated risk to a level acceptable to Range Safety throughout the system life cycle.

The SSPP **shall** provide a detailed SSPP to describe how the project will implement a safety program in compliance with launch range requirements. Integration of system/facility safety provisions into the SSPP is vital to the early implementation and ultimate success of the safety effort.

The SSPP **shall** address the following areas:

1) System safety organization, interfaces, and responsibilities
2) System safety methodologies
3) Internal safety review process
4) Launch site safety
5) Verification and operating procedures
6) Hazardous operation surveillance
7) Accident investigation and reporting
8) Operator training and certification
9) Safety audits
10) Monitoring of subcontractors
11) Documentation to be provided
12) Milestone schedules of all major activities

13) Procedure for reporting problems and activity status

14) Industrial safety program responsibilities, functions, and interfaces with the system safety program

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
MA-11	Safety Data Package (SDP)

3. <u>Use:</u>

Provides a detailed description of the payload design sufficient to support hazard analysis results, hazard analysis method, and other applicable safety related information.

4. <u>Preparation Information:</u>

NOTE: The first MSPSP delivery **shall** contain appropriate launch range safety requirements tailoring (if necessary).

*(See applicable launch range and launch vehicle requirements for details).

The SDP **shall** include analyses identifying the ground operations hazards associated with the flight system, ground support equipment, and their interfaces.

The SDP **shall** include measures to control and/or minimize each significant identified hazard.

In addition to identifying hazards, the SDP **shall** also identify applicable hazard controls, and verifications methods for each hazard, and document them in Hazard Reports.

The SDP hazard analysis **shall** be updated as the hardware progresses through the stages of design, fabrication, and test.

A list of all hazardous/toxic materials and associated material safety data sheets **shall** be included in the final SDP, as well as a detailed description of the hazardous and safety critical operations associated with the payload.

The spacecraft Project Manager **shall** demonstrate compliance with these requirements and **shall** certify to GSFC and the launch range, through the SDP, that all safety requirements have been met.

The Safety Data Package **shall** include the following information:

1) Introduction. State, in narrative form, the purpose of the safety data package.

2) System Description. This section may be developed by referencing other program documentation such as technical manuals, System Program Plan, System Specification. As applicable, either photos, charts, flow/functional diagrams, sketches, or schematics to support the system description, test, or operation.

3) System Operations.

    a. A description or reference of the procedures for operating, testing and maintaining the system. Discuss the safety design features and controls incorporated into the system as they relate to the operating procedures.

    b. A description of any special safety procedures needed to assure safe operations, test and maintenance, including emergency procedures.

c. A description of anticipated operating environments and any specific skills required for safe operation, test, maintenance, transportation or disposal.

d. A description of any special facility requirements or personal equipment to support the system.

4) Systems Safety Engineering Assessment. This section **shall** include:

a. A summary or reference of the safety criteria and methodology used to classify and rank hazardous conditions.

b. A description of or reference to the analyses and tests performed to identify hazardous conditions inherent in the system.

c. Hazard Reports for all hazards by subsystem or major component level that have been identified and considered from the inception of the program.

i. A discussion of the hazards and the actions that have been taken to eliminate or control these items.

ii. A discussion of the effects of these controls on the probability of occurrence and severity level of the potential mishaps.

iii. A discussion of the residual risks that remain after the controls are applied or for which no controls could be applied.

iv. A discussion of or reference to the results of tests conducted to validate safety criteria requirements and analyses. These items **shall** be tracked and closed-out via the Verification Tracking Log (VTL) per CDRL No. 3-7.

d. Results of Operating and Support Hazard Analysis performed to evaluate procedurally controlled activities for hazards or risk introduced into the system during pre-launch processing (i.e. launch site or processing facilities) and adequacy of procedures used to eliminate, control, or abate identified hazards or risks.

e. Results of Software Safety Analysis performed to evaluate hazards caused by software. Section 5 of the MAR describes desired software safety activities to meet NASA HQ guidelines.

5) Conclusions and Recommendations. This section **shall** include:

a. A short assessment of the results of the safety program efforts. A list of all significant hazards along with specific safety recommendations or precautions required ensuring the safety of personnel and property.

b. For all hazardous materials generated by or used in the system, the following information **shall** be included.

i. Material identification as to type, quantity, and potential hazards.

ii. Safety precautions and procedures necessary during use, storage, transportation, and disposal.

iii. A copy of the Material Safety Data Sheet (OSHA Form 20 or DD Form 1813) as required.

c. Appropriate radiation forms/analysis.

d. Reference material to include a list of all pertinent references such as Test Reports, Preliminary Operating Manuals and Maintenance Manuals

e. A statement signed by the Contractor System Safety Manager and the Program Manager certifying that all identified hazards have been eliminated or controlled and that the system is ready to test, operate, or proceed to the next acquisition phase. In addition, include recommendations applicable to the safe interface of this system with the other system(s).

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
MA-12	Missile System Pre-Launch Safety Package

3. Use:

Demonstrate that the spacecraft, its interfaces, GSP, and procedures comply with ER and NASA Safety Requirements.

4. Preparation Information:

A Missile System Pre-Launch Safety Package (MSPSP) **shall** be submitted for each spacecraft to be launched. Contents will be in accordance with Eastern Range Safety Requirements 127-1.

The MSPSP revisions **shall** reflect:

1) All changes made in the hazard control and safety assessment of the spacecraft, the ground support equipment or launch operation procedures since the last submittal.

2) All information and data that are peculiar to the individual spacecraft and its launch operations, such as GSE design changes, ground processing, related failure and accident summaries, open item lists, etc.

Each MSPSP submittal or supplemental submittal **shall** include addenda and updates required to ensure that the data package is current for each spacecraft launch.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
MA-13	Safety Non-Compliance / Waiver Requests

3. <u>Use:</u>

Documents variances of safety requirements that can not be met; explains the rationale for approval of each variance, as defined in NPR 8715.3

The Safety Non-Compliance / Waiver Requests may require Range Safety concurrence for the variance to be approved.

4. <u>Preparation Information:</u>

A Safety Non-Compliance / Waiver Request **shall** include the following information resulting from a review of each waiver or deviation request:

1) A statement of the specific safety requirement and its associated source document name and paragraph number, as applicable, for which a waiver or deviation is being requested.

2) A detailed technical justification for the exception.

3) Analyses to show that the mishap potential of the proposed alternate requirement, method or process, as compared to the specified requirement.

4) A narrative assessment of the risk involved in accepting the waiver or deviation. When it is determined that there are no hazards, the basis for such determination should be provided.

5) A narrative on possible ways of reducing hazards severity and probability and existing compliance activities (if any).

6) Starting and expiration date for waiver/deviation.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
MA-14	Project Pre-Mishap Plan Input

3. <u>Use:</u>

To understand the Contractor's role, responsibility, and procedures to be implemented in the event of a mishap.

4. <u>Preparation Information:</u>

The Project Pre-Mishap Plan Input **shall** address the following at a minimum:

1) Procedures for the appointment of an Incident Commander and a Contractor Interim Response Team
2) Procedures for safing, handling, or containing hazardous chemicals in the hardware.
3) Procedures for emergency response personnel (e.g., identification and handling of hazardous commodities).
4) Describe how a mishap site **shall** be secured.
5) Describe how debris **shall** be collected, transported, and stored.
6) Procedures to impound data, records, equipment, facilities, and property at the contractor's facility.
7) Identify the local organizations and agencies, which are most likely to take part in emergency response;
8) Identify existing memoranda of agreement (if applicable) with national, state, and local organizations and
9) Procedures for reporting a mishap or close calls within the Contractor's organization as well as to GSFC.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
MA-15	Mishap Reports

3. Use:

To document and report mishaps and close calls to GSFC

4. Preparation Information:

The Mishap Report **shall** be documented in accordance with NPR 8621.1, NASA Procedures and Requirements for Mishap Reporting.

Note: NPR 8621.1 defines a Close Call as an occurrence or a condition of employee concern in which there is no injury or only minor injury requiring first aid and no significant equipment/property damage (less than $1000), but which possesses a potential to cause a mishap.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
MA-16	Safety Requirements Compliance Checklist

3. Use:

To demonstrate if the proposed design is compliant, non-compliant but meets intent, non-compliant (waiver required) or non-applicable.

4. Preparation Information:

A Safety Requirements Compliance Checklist of all design, test, analysis, and data submittal requirements **shall** be provided for each requirement of the AFSPCMAN 91-710, Range Safety User Requirements.

The following items **shall** be included in the Safety Requirements Compliance Checklist:

1) Criteria/requirement.
2) System.
3) Compliance.
4) Noncompliance.
5) Not applicable.
6) Resolution.
7) Reference.
8) Copies of all Range Safety approved non-compliances including waivers and equivalent levels of safety

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: **2. Title:**

MA-17 Preliminary Hazard Analysis

3. Use:

The Preliminary Hazard Analysis (PHA) is used to obtain an initial risk assessment and identify safety critical areas of a concept or system. Based on the best available data, including mishap data from similar systems and other lessons learned.

The PHA identifies safety provisions and alternatives needed to eliminate hazards or reduce their associated risk to a level acceptable to GSFC.

4. Preparation Information:

The Preliminary Hazard Analysis **shall** include safety provisions and alternatives needed to eliminate hazards or reduce their associated risk to an acceptable level.

The PHA **shall** be based on the hazard assessment criteria provided in Chapter 3 of NPR 8715.3, to obtain an initial risk assessment of the system.

In the PHA, based on the best available data, including mishap data (if assessable) from similar systems and other lessons learned, hazards associated with the proposed design or function **shall** be evaluated for hazard severity, hazard probability, and operational constraint.

The PHA **shall** consider the following for identification and evaluation of hazards at a minimum:

1) Hazardous components.

2) Environmental constraints including the operating environments.

3) Operating, test, maintenance, built-in-tests, diagnostics, and emergency procedures.

4) Facilities, real property installed equipment, support equipment.

5) Safety related equipment, safeguards, and possible alternate approaches.

6) Safety related interface considerations among various elements of the system. This **shall** include consideration of the potential contribution by software to subsystem/system mishaps. Safety design criteria to control safety-critical software commands and responses **shall** be identified and appropriate action taken to incorporate them in the software (and related hardware) specifications.

7) Malfunctions to the system, subsystems, or software. Each malfunction **shall** be specified, the causing and resulting sequence of events determined, the degree of hazard determined, and appropriate specification and/or design changes developed.

8) Include a system description and a description of the methodology used to develop the analysis.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: MA-18

2. Title: Operations Hazard Analysis

3. Use:

The Operations Hazard Analysis (OHA) addresses the implementation of safety requirements for personnel, all procedures, and equipment used during, testing, transportation, storage, and integration operations.

4. Preparation Information:

The Operations Hazard Analysis shall include:

1) A Hazard Tracking Log **shall** be generated to track and close all remaining OHA open items.

2) GSFC will review/approve the OHA prior to initiating any I&T activities.

3) Hazard Tracking Log (HTL) open items **shall** be transferred to a Verification Tracking Log (VTL) which **shall** have closure methodology as determined in the CDRL No. 3-7.

The OHA **shall** include the following information:

1) Introduction

    a. Provide an abstract summarizing the major findings of the analysis and the proposed corrective or follow-up actions.

    b. Define any special terms, acronyms, and/or abbreviations used.

2) System Description

    a. Provide a description of the system hardware and configuration. List components of subsystems.

    b. The most recent schedules for integration and testing of the instrument/spacecraft.

    c. Photographs, diagrams, and sketches should be included to support the test.

3) Analysis of System Hazards

    a. The analysis **shall** identify all real or potential hazards presented to personnel, equipment, and property during I&T processing.

    b. A listing of all identified hazards **shall** be provided in a tabulated format. Each hazard **shall** be numbered and **shall** include the following information:

        i. System Component/Phase. The particular phase/component that the analysis is concerned with. This could be a system, subsystem, component, operating/maintenance procedure or environmental condition.

ii. System Description and Hazard Identification, Indication.

1. A description of what is normally expected to occur as the result of operating the component/subsystem or performing the operating/maintenance action.

2. A complete description of the actual or potential hazard resulting from normal actions or equipment failures. Indicate whether hazard will cause personnel injury and/or equipment damage.

3. A description of crew indications which include all means of identifying the hazard to operating or maintenance personnel.

4. A complete description of the safety hazards of software controlling hardware systems where the hardware effects are safety critical.

iii. Effect on System. The detrimental results an uncontrolled hazard could inflict on the whole system.

iv. Risk Assessment. A risk assessment for each hazard as defined in paragraph **shall** be provided.

v. Caution and Warning Notes. A complete list of specific warnings, cautions, procedures required in operating and maintenance manuals, training courses, and test plans.

vi. Status/Remarks.

1. The status of actions to implement the recommended, or other, hazard controls.

2. Any information relating to the hazard, not covered in the other blocks, for example, applicable documents, previous failure data in similar systems, or administrative directions.

4) References. List all pertinent references such as test reports, preliminary operating and maintenance manuals, and other hazard analysis.

5) Appendices. The appendix will contain charts, graphs, or data which are too cumbersome for inclusion in the previous sections, or are applicable to more than one section. It may also contain detailed formulation or analysis which is more conveniently placed in an appendix.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
MA-19	Responses to Alerts

3. Use:

To inform GSFC of the extent of impact of all reported GIDEP Alerts on the contract hardware so that the Project can plan appropriate corrective actions.

4. Preparation Information:

Responses to Alerts **shall** indicate which if any alerts have impact to contract hardware.

Responses to Alerts **shall** provide contractor proposed follow up action.

Initial Responses to Alerts **shall** be updated as any Alert report is updated by GIDEP.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: **2. Title:**

MA-20 GIDEP Alert / NASA Advisory Disposition

3. Use:

To document the developer's disposition of GIDEP ALERTs; GIDEP SAFE-ALERTs; GIDEP Problem Advisories; GIDEP Agency Action Notices; NASA Advisories and component issues, hereinafter referred to collectively as "Alerts" with respect to parts and materials used in NASA product. The disposition documents that the Alerts either do not apply to NASA product or that the Alerts effect has been mitigated.

4. Preparation Information:

GIDEP Alert / NASA Advisory Disposition **shall** include:

- A list in accordance with the requirements of the appropriate DID of Section 11 or Section 13 with a notation for each line item as to whether there are applicable Alerts.
- The lists submitted per Section 11 and Section 13 **shall** be updated with Alert information as parts and materials are added.
- GSFC Form 4-37, "Problem Impact Statement Parts, Materials and Safety" or equivalent developer form, for Alerts provided by the GSFC Project Office.

An equivalent developer form for GIDEP Alert / NASA Advisory Disposition **shall** include the following elements:

1) Impact Statement Preparer:

Note: This item does not require completion if the message sender is the same as the impact evaluator.

2) Project Name (s):

3)

a. Has the project procured (or is planning to procure any parts, materials, or services) from the referenced manufacturer (s)?

Place a X in appropriate area: Yes: No:

b. If yes to 3A, does the project have the affected (or similar) part numbers?

Place a X in appropriate are: Yes: No:

c. If Yes to 3B, list affected part numbers along with lot date codes.

d. If Yes to 3B, narratives are required for sections 4 and 5.

4) Impact on Projects

Effective Date: (Date of last signature)

5) Action Taken

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: MA-21

2. Title: Failure Mode and Effects Analysis (FMEA) and Critical Items List (CIL) Report

3. Use:

The FMEA is a reliability analysis to evaluate design relative to requirements, identify single point failures, and identify hazards so as to guide preventive design actions. The CIL provides a list of critical items, which require the highest level of attention in design, fabrication, verification, and problem correction during the development, handling, and mission use of the system.

4. Preparation Information:

The FMEA and CIL report **shall** document the analysis including:

1) Approach, methodologies, assumptions, results, conclusions, recommendations, and corrective actions;

2) Objectives, level of the analysis, ground rules, functional description, functional block diagrams, reliability block diagrams, bounds of equipment analyzed, reference to data sources used, identification of problem areas, single-point failures, recommended corrective action, and worksheets as appropriate for the specific analysis being performed;

3) Item identification, cross-reference to FMEA line items, and retention rationale for each item on the CIL. Appropriate retention rationale may include design features, historical performance, acceptance testing, manufacturing product assurance, elimination of undesirable failure modes, and failure detection methods.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
MA-22	Limited Life Items List

3. Use:

Defines and tracks the selection, use and wear of limited-life items and the impact on mission operations.

4. Preparation Information:

The Limited Life Items List **shall** list life-limited items and their impact on mission parameters.

The Limited Life Items List **shall** define the expected life, required life, duty cycles, and rationale for selecting and using the items.

The Limited Life Items List **shall** include selected structures, thermal control surfaces, and electromechanical mechanisms. Atomic oxygen, solar radiation, shelf-life, extreme temperatures, thermal cycling, wear and fatigue are used to identify limited-life thermal control surfaces and structural items. When aging, wear, fatigue and lubricant degradation limit their life, include compressors, seals, bearings, valves, gyros, actuators and scan devices.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
MA-23	Request for Use of Multi-Mission or Previously Designed, Fabricated, or Flown Hardware

3. <u>Use:</u>

Description of contractor's approach and methodology for implementing Multi-Mission or Previously Designed, Fabricated, or Flown Hardware, including flow-down of applicable requirements to sub-developers.

4. <u>Preparation Information:</u>

The Request for Use of Multi-Mission or Previously Designed, Fabricated, or Flown Hardware **shall** demonstrate how the hardware complies with requirements.

The Request for Use of Multi-Mission or Previously Designed, Fabricated, or Flown Hardware **shall** include as a minimum the following:

1) List of previous mission(s) used on.

2) Levels to which this hardware was qualified.

3) Parts list

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
MA-24	Parts Stress Analysis Report

3. Use:

Provides EEE parts stress analyses for verifying circuit design conformance to derating requirements; demonstrates that environmental operational stresses on parts comply with project derating requirements.

4. Preparation Information:

The Parts Stress Analyses Report **shall** contain:

1) Analyses ground rules;
2) Reference documents and data used;
3) Results and conclusions including impact on design and risk decisions;
4) Part identification (traceable to circuit diagrams);
5) Assumed environmental conditions (consider all expected environments);
6) Derating factors and parameters; and
7) Rated stress and actual operating stress.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: MA-25

2. Title: Worse Case Analyses Report

3. Use:

To demonstrate the adequacy of margin in the design of electronic and electrical circuits, optics, and electromechanical and mechanical items.

4. Preparation Information:

The Worst Case Analyses Report **shall**:

1) Identify the part, subassembly, or assembly being analyzed;

2) Provide verification that the part, subassembly, or assembly performs properly for the mission life under all minimum and maximum parameter limits including the effects of environmental stresses;

3) Include all calculations relevant to the analysis;

4) Include any problems or potential problems with the part, subassembly, or assembly; and

5) Include any recommendations to correct any problems or potential problems noted during the analysis.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
MA-26	Reliability and Probabilistic Risk Assessment (PRA) Program Plan

3. Use:

To provide planning, scheduling, and control for the reliability and Probabilistic Risk Assessment program.

4. Preparation Information:

The Reliability and Probabilistic Risk Assessment Program Plan **shall**:

1) Describe how the contractor will interact with the Instrument and Ground System contractors to perform the "full scope" PRA for a Class A mission per NPR 8705.4 and NPR 8705.5;

2) Identify the tasks the contractor will perform, and describe how the tasks will be scheduled relative to project milestones, implemented, and controlled;

3) Describe the activities that ensure reliability and PRA functions are an integral part of the design and development process;

4) Describe how reliability and PRA functions interact effectively with other project disciplines, including systems engineering, risk management, hardware design, software design, and product assurance practices to maximize the probability of meeting mission success criteria;

5) Describe how reliability analyses and PRA will incorporate definitions of failure, including alternate and degraded modes of operation in determining acceptable and unacceptable levels of performance; and

6) Describe how the limited-life items will be identified and managed.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
MA-27	Reliability Block Diagrams and Predictions Report

3. Use:

Provide a structured, disciplined approach to analyzing system risk to support management decisions to: ensure mission success; improve safety in design, operation, maintenance and upgrade; improve performance; and reduce design, operation and maintenance costs.

4. Preparation Information:

The Reliability Block Diagrams and Predictions Report **shall** document the methodology and results of comparative reliability assessments including mathematical models, reliability block diagrams, failure rates, failure definitions, degraded operating modes, trade-offs, assumptions, and any other pertinent information used in the assessment process.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
MA-28	Probabilistic Risk Assessment (PRA) Report

3. <u>Use:</u>

Probabilistic Risk Assessment is a systematic and comprehensive methodology to evaluate risks associated with every life-cycle aspect of a complex engineered technological entity (e.g., spacecraft, instruments, ground systems, etc.) from concept definition, through design, construction and operation, and up to removal from service.

4. <u>Preparation Information:</u>

The PRA Report **shall** document the "full-scope" Probabilistic Risk Assessment for a Class A mission performed per NPR 8705.4 and NPR 8705.5 for the GOES-R mission with support from the Instrument and Ground System contractors, that includes:

1) The approach, methodology, results (e.g., the identification of high risk scenarios), conclusions, recommendations for corrective actions, and corrective actions taken;

2) Objectives, scope, level of analysis, ground rules, and assumptions;

3) Identification of all end states of specific decision-making interest, initiating events, and scenarios that could result in these end states;

4) Definition of the mission phases, operations concept, and success criteria;

5) Initiating and pivotal event models (e.g., Event Sequence Diagrams, Event Trees, Fault Tree Analysis, and phenomenological event models);

6) Data development for probability calculations, including software failure likelihood estimates;

7) An integrated model and quantification to obtain risk scenarios and estimates; and

8) An assessment of uncertainties.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: MA-29

2. Title: Trend Analysis Plan and Data Reports

3. Use:

To monitor parameters on assemblies and subsystems throughout the normal test program that relate to performance stability (any deviations from the nominal that could indicate trends). NOAA operational personnel will continue monitoring trends through mission duration.

4. Preparation Information:

The Trend Analyses Plan **shall** document the system for selecting parameters related to performance stability, recording any changes from the nominal, analyzing trends, and coordinating results with design and operational personnel.

The Trend Analyses Plan **shall** list the identified key parameters that relate to performance stability.

Trend Data Reports **shall** document parameter trends starting at assembly acceptance testing and continuing during the system integration and test phases; these parameters are to be monitored for trends leading towards loss of stability of operation.

The Trend Analysis Plan and Data Reports **shall** contain a log that maintains the accumulated operating time and includes the following information, as a minimum:

1) Identification of hardware item;
2) Serial number;
3) Total operating time since assembly as a unit;
4) Total operating time since last failure;
5) Total additional operating time projected for the unit prior to launch;
6) Identification of key parameters being monitored;
7) Upper/lower spec tolerance limit for each parameter being monitored;
8) Summary statement of any trending noted in earlier measurements of each parameter;
9) Observed value (in sequence) for the reporting interval; and
10) Assessment of trends to date.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: **2. Title:**

MA-30 Orbital Debris Assessment

3. Use:

To ensure NASA requirements for post mission orbital debris control are met.

4. Preparation Information:

The Orbital Debris Assessment **shall** be in accordance with NSS 1740.14, Guidelines and Assessment Procedures for Limiting Orbital Debris.

The PDR Orbital Debris Assessment **shall** identify areas where the program or project might contribute debris and to assess this contribution relative to the guidelines in so far as is feasible.

Prior to CDR another Orbital Debris Assessment **shall** comment on changes made since the PDR report.

The level of detail in the Orbital Debris Assessment **shall** be consistent with the available information of design and operations.

When there are design changes after CDR that impact the potential for debris generation, an update of the Orbital Debris Assessment **shall** be prepared, approved, and coordinated with the Office of System Safety and Mission Assurance.

Orbital Debris Assessment Software is available for download from Johnson Space Center at URL:

http://sn-callisto.jsc.nasa.gov/mitigate/das/das.html

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: **2. Title:**

MA-31 Verification Tracking Log

3. Use:

Provides documentation of a Hazard Control and Verification Tracking process or "closed-loop system" that assures safety compliance has been satisfied in accordance to AFSPCMAN 91-710, Range Safety User Requirements.

4. Preparation Information:

A payload safety Verification Tracking Log (VTL) identifying hazard controls still not verified or closed **shall** be prepared and delivered to GSFC.

Open VTL items **shall** be closed with appropriate documented rationale prior to first operational use/restraint.

The Hazard Log (or VTL) **shall** provide documentation that demonstrates the process of verifying the control of all hazards by test, analysis, inspection, similarity to previously qualified hardware, or any combination of these activities.

All verifications that are listed on the hazard reports **shall** reference the tests/analyses/inspections.

Results of these tests/analyses/inspections **shall** be available for review and submitted in accordance with the contract schedule and applicable launch site range safety requirements.

The VTL **shall** contain the following information in tabular format:

1) Log
2) Hazard Report #
3) Safety Verification #
4) Description (Identify procedures/analyses by number and title)
5) Constraints on Launch Site Operations
6) Independent Verification Required (i.e., mandatory inspection points)? Yes/No
7) Scheduled Completion Date
8) Completion Date
9) Method of Closure

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-MNGT-01	Component/Unit Level Design Specifications

3. Use:

The Component/Unit Level Design Specifications will be used to define and document the performance, design, and test verification requirements for all Spacecraft Component and Unit Level Assemblies.

4. Preparation Information:

Electronic or Hardcopy as applicable

The contractor **shall** provide guaranteed access to specifications for each Spacecraft Component and Unit Level Assembly.

Contractor Defined Format.

The Component/Unit Level Design Specifications **shall** include, but not be limited to, the following items:

1) Performance requirements and capabilities (may be provided for informational purposes)
2) Mechanical and electrical interfaces.
3) Performance verification requirements
4) Performance assurance requirements
5) Grounding and shielding requirements
6) Radiation design requirements
7) Functional and/or block diagram(s)
8) Component specification requirements

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-MNGT-02	Spacecraft Photo and Video Plan

3. Use:

To provide a detailed historical record of the electrical and mechanical assembly details for each spacecraft.

4. Preparation Information:

Photographs should be of sufficient resolution to assist in failure investigations and anomaly resolution

Photographs **shall** be taken of:

1) Appendage assemblies, separation mechanisms and configured component installations, showing critical mechanical configurations including cable routing and supports; mechanical mechanisms; pre- and post-thermal blanket installation

2) Subsystem integration and test, documenting the flight hardware, as integrated on the spacecraft (e.g., propulsion system, power system, harnesses, etc.)

3) The spacecraft, its subsystems and components throughout various stages of spacecraft integration and test, documenting the flight hardware, system test configurations, and spacecraft handling activities

The contractor **shall** provide still photography--one or more 8x10 (or larger) color prints of each of the following activities before final encapsulation, cover-up or final assembly, for the GOES-R spacecraft.

At a minimum, the following events **shall** be photographed during closeout operations at the S/C contractor's facility, as applicable (pre-shipment), and at launch base:

1) Final closeout at the S/C contractor's facility prior to shipping:

    a. Interior of each area of the Spacecraft (S/C) prior to final closure.

    b. Exterior of the S/C

    c. All deployable appendages, including hinges, hold-downs, insulation blankets near deployables, antennas, etc.

    d. Exterior of S/C installed in shipping container prior to lid closure, including mounting points, purge lines, thermistors, accelerometers, etc.

2) At the launch base:

    a. Spacecraft fueling operations including layout of the spacecraft, fueling GSE, hoses, etc.

    b. Exterior of the S/C upon receipt at the payload processing facility

    c. Interior of the S/C prior to final closeout for launch

d. Final stowage condition of all deployables prior to encapsulation into the launch vehicle (LV) fairing.

e. Final condition of all antennas prior to LV encapsulation.

f. Removal sites of all red tag items prior to LV encapsulation (including thruster covers, earth and sun sensors protective covers, lifting eye bolts, etc.)

g. Exterior of the S/C prior to encapsulation

h. Prior to LV fairing door closure on the pad, photograph the sites of any removed purged lines, electrical connections, etc.

These photographs and their negatives **shall** be retained by the contractor and be made available for review by the Government upon request.

The contractor **shall** incorporate a detailed list(s) of photographs to be taken prior to the applicable phases discussed above, through shop orders, procedures, or Program-specific Quality Instructions.

All photographs **shall** be annotated with information showing date, spacecraft, and unit identification.

Identical sets of photographs **shall** be taken for each spacecraft.

Videos **shall** be taken at the S/C contractor's facility of all moves of the spacecraft, major subsystems, and large components, all appendage deployments and dynamic environmental tests -with the exception of acoustic testing if CCTV is precluded due to facility constraints.

Videos will also be taken of all moves and lifts of the spacecraft at the payload processing facility. This can be done in coordination with the payload processing facility operator

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: SC-MNGT-03

2. Title: Component/Unit Level Test Plans

3. Use:

Component/Unit Level Test Plans provide an overall description of the GOES-R Component and Unit Level Test Program, and define the specific tests and analyses that collectively demonstrate compliance with applicable specification and programmatic requirements.

Qualification and Acceptance level testing should be addressed.

4. Preparation Information:

The contractor **shall** provide guaranteed access to test plans for each Spacecraft Component and Unit Level Assembly.

Contractor defined format.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-MNGT-04	Component/Unit Level Test Procedures

3. Use:

Component and Unit Level Test procedure documents will be used to review the Qualification and Acceptance test activity at the Component and Unit levels of assembly.

4. Preparation Information:

The contractor **shall** provide guaranteed access to test procedures for each Spacecraft Component and Unit Level Assembly.

Component/Unit Level Test Procedures **shall** document the test implementation, as flown down from the applicable Component and Unit Level Test Plan.

Contractor defined format.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: SC-MNGT-05

2. Title: Component/Unit Level Data Packages

3. Use:

Component/Unit Level Data Packages provide a comprehensive record documenting the results of the as-run Component/Unit Level Test Procedures. The Data Package identifies which test objectives were accomplished, how well predicted performance was validated by the test data, and any other significant events. Qualification and Acceptance level testing should be addressed.

4. Preparation Information:

The contractor **shall** provide guaranteed access to data packages for each Spacecraft Component and Unit Level Assembly.

The contractor **shall** evaluate the data taken during Component and Unit Level testing for conformance with the applicable specification and programmatic requirements.

Contractor defined format.

As a minimum, the data package **shall** contain:

1) Test data
2) Evidence of Quality Assurance acceptance data
3) Listing of test requirements verified
4) Summary description and commentary on the test data package
5) Test procedures as run
6) Test procedure change record listing
7) Data trending
8) Analysis used to demonstrate compliance with component requirements
9) Configuration identification list
10) Material review actions resulting from the tests
11) Test equipment calibration data
12) Failure report listing and copies as required, (including status/resolution if completed by submittal)
13) Operating time/cycle data

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: SC-MNGT-06

2. Title: Spacecraft Operations Handbook (SOH)

3. Use:

The Satellite Operations Handbook(s) provide comprehensive documentation on all aspects of spacecraft operations in a multi-volume set.

4. Preparation Information:

The SOH **shall** provide detailed information required for mission operations planning and development, spacecraft operation, analysis, and anomaly resolution in a comprehensive multi-volume set. GFE instrument operations information will be integrated to provide a single, comprehensive reference for the entire satellite.

Electronic format of SOH volumes **shall** have ability to hyperlink to other SOH Volumes and other contractor supplied operations documents.

The section below defines the Content by Volume assignments. Individual data item descriptions have been prepared for each volume of the SOH.

All changes to the SOH following the Initial delivery at L-24 months **shall** be clearly identified in the updated version.

Volume/Content Definitions:

Volume 1 –Mission Profile and Launch Operations

Volume 2 –Contingency Operations

Volume 3 –Spacecraft Description (Including GFE Instruments and Mechanisms)

Volume 4 –On-Orbit Operations

Volume 5 –On-Board Computer User’s Operations and Maintenance Manual

Volume 6,7, 8 –GOES R/S/T Spacecraft Specific Data

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:

SC-MNGT-06

2. Title:

SOH Volume 1 : Mission Profile and Launch Operations

3. Use:

SOH Volume 1 provides a detailed mission analysis, including a description of the purpose and scope of the mission. SOH Volume 1 includes detailed descriptions of all pre-launch activities, and launch and transfer orbit operations.

4. Preparation Information:

Electronic format of SOH volumes **shall** have ability to hyperlink to other SOH Volumes and other contractor supplied operations documents.

SOH Volume 1 **shall** provide detailed launch operations and procedures including:

1) Pre-Launch Activities –How and when the spacecraft is configured at the launch facility.

2) Launch and Orbital Consideration –Includes a description of the transfer orbit maneuver plan (if not direct injection), mission impacts of injection accuracy, solar and lunar aspects, sensor FOVs, power availability, sizing and payload capabilities of spacecraft engines, available telemetry during maneuvers, maneuver profiles, burn durations, fuel and mass margins, maneuver abort criteria, engine thermal characteristics and thruster alignment data.

3) Spacecraft Launch Constraints –List of all conditions required for the launch to take place and a list of all conditions which would preclude launch. Provide detailed explanations of all GO/NOGO criteria.

4) Launch Vehicle Characteristics –Overview of relevant information including available spacecraft telemetry during launch, launch profile, burn durations, fuel and mass margins, and final separation configuration.

5) Ground Station Coverage –Predicted station availability (look angles, maximum elevation, support duration, possible site conflicts) as function of launch date and time. Detailed description of all external element interfaces to the NOAA SOCC and Ground Network (GN) sites.

6) T&C Requirements –All telemetry monitoring and command execution required between launch and checkout orbit injection

7) Detailed Launch Timeline –Specific sequence of activities to be carried out from launch until orbital checkout station attainment, through engineering handover. This should include deployment of appendages and spacecraft functional checkout.

8) Launch Communications/Data Flow Requirements –All requirements for data or communications during launch including data rates, line availability, duration of service, back-up service configuration and failover cases.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
SC-MNGT-06	SOH Volume 2 : Contingency Operations

3. <u>Use:</u>

SOH Volume 2 provides a detailed description of contingency prevention, detection, and manufacturer's recommended response to deviations from expected launch and operational modes.

4. <u>Preparation Information:</u>

Electronic format of SOH volumes **shall** have ability to hyperlink to other SOH Volumes and other contractor supplied operations documents.

The SOH Volume 2 **shall** include the following:

- Contingency Operations Procedures –Describe for each mission phase, in flow chart form, every use of telemetered data to assess the health and safety of all satellite components and subsystems, and to determine when any deviation from expected performance requires action. Describe in flow chart form and text, the immediate actions to be taken by the operations staff when each of these expected conditions is not true. Include exact telemetry to be monitored, pre-requisite conditions to be met, and all procedures, plans, and commands to be sent to maintain the short-term health of the flight system and steps to recover normal operations. The flow charts will highlight operations including single points of failure which exists on the as-built spacecraft. Include any special configurations or interaction with the ground system required for a particular contingency.

- Redundant Devices, Components and Systems –For each redundant device, component, and system, describe how the unit is switched to its backup unit and all operational impacts of performing the switch to the backup side.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-MNGT-06	SOH Volume 3 : Spacecraft Description

3. Use:

SOH Volume 3 provides supporting information for the development of spacecraft operations procedures and practices. Volume 3 includes detailed component-level descriptions of the operation of each subsystem and payload, including operational constraints and all interactions with other subsystems and payloads. SOH Volume 3 is used extensively by the Flight Operations Team, and as such requires must reflect a comprehensive and very detailed level of technical documentation.

4. Preparation Information:

Electronic format of SOH volumes **shall** have ability to hyperlink to other SOH Volumes and other contractor supplied operations documents.

SOH Volume 3 **shall** include, as a minimum, the following information. Extensive usage of figures, tables, and block diagrams should be included for clarity.

1) Mission Overview –Detailed description of overall GOES System including the interface between the space and ground segment. Include individual descriptions of the space segment, ground segment, and operations aspect. Operations phases should include LOR, post-launch testing, normal on-orbit operations, on-orbit storage, and spacecraft end-of-life disposal.

2) Spacecraft Subsystem Description –A detailed description of each subsystem should be provided, including subsystem internal interface and operation, and interface and interactions with other subsystems. As a minimum, include the following information in the subsystem description:

   a. Subsystem Description -Include block diagrams to depict internal and external subsystem interfaces and subsystem function.

   b. Subsystem Thermal Environment –Identify component and unit level expected normal operating temperatures, survival temperatures, and any operationally related thermal constraints/restrictions.

   c. Subsystem General Characteristics –Subsystem component and unit level assembly locations should be identified. Include component and unit level assembly weights, and physical dimensions. Subsystem power consumption by component/unit should be detailed.

   d. Command and Telemetry Data Sets –Identify subsystem command and telemetry data sets, including selectable command options. This information can be provided as a subsystem specific hyperlink to the Spacecraft Command and Data Handbook. (TBR)

   e. Subsystem Component Description –Provide detailed description of component (e.g. RF switches) and unit level assemblies, including unit level functional block diagrams. For units with modules containing multiple slices, slice partitioning should be itemized by service/function. Include detailed description of subsystem redundancy, and fault detection and correction capabilities. Identify known degraded performance operational mode capabilities.

f. Microprocessor Based Systems –Provide description of interrupt architecture, memory architecture and mapping, system initialization, hardware fault protection, I/O interfaces with other subsystems, and system level error/error code definitions.

g. Software –Hyperlink to the Software Maintenance Manual

h. Operational Modes –For subsystems with multiple operational modes provide a description of subsystem operational modes (e.g. mode vs. mission phase associations), mode drivers and constraints, and mode unique command and telemetry relationships.

i. Maintenance Requirements –Provide description, schedule, and procedure for implementing subsystem maintenance requirements.

j. Mechanisms –Provide detailed descriptions of all mechanisms. This should include figures depicting stowed and deployed configurations, location of the mechanism, mechanism dimensional information, detailed drawings of each mechanism (Include cross-sectional drawings). Slip-ring to harness assignments should be provided for the Solar Array Drive mechanism.

k. RF Communications –RF Communications subsystem command and receiver information should include EIRP, frequency, antenna characteristics, data rates, data formats, subcarrier scheme, dynamic range, G/T, and ETE BER performance specifications.

l. Need to verify contract mechanism for GFE contractors to provide required information. (TBR)

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-MNGT-06	SOH Volume 4 –On-Orbit Operations

3. Use:

SOH Volume 4 provides detailed descriptions of nominal spacecraft operations for the GOES-R mission.

4. Preparation Information:

Electronic format of SOH volumes **shall** have ability to hyperlink to other SOH Volumes and other contractor supplied operations documents.

The SOH Volume 4 **shall** describe spacecraft on-orbit capabilities and operating modes.

SOH Volume 4 **shall** include the following information:

1) Describe the performance capabilities of all subsystems when in the on-orbit configuration. Describe each possible operating mode, means of transition, and constraints on operation in each mode.

2) Describe standard operating procedures to a level of detail sufficient to address all prerequisite conditions, dependencies, constraints, proper sequence, and verification of any individual command or command set necessary to accomplish normal flight operations tasks.

3) Describe special event operations (e.g. Storage Mode and special orbit maneuver execution) to a level of detail consistent with the normal operations procedures.

4) Describe all routine maintenance events such as orbit adjustments, momentum management, and solar array adjustments. Address in detail all procedures necessary to accomplish these tasks.

5) Performance Assessment (Monitoring Guidelines) -Provide detailed description of which performance parameters are to be trended and at what frequency. Describe expected trends and identify possible deviations from normal that may indicate degradation or impending failure of a component or subsystem, or that otherwise may affect satellite performance.

6) Describe on-orbit storage mode operations –Include recommend pre-storage operations activities and storage mode acquisition, on-orbit storage operations, and operations required to remove the spacecraft from storage and return it to normal operational mode.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-MNGT-06	SOH Volume 5 –On-Board Computer (OBC) User's Operations and Maintenance Manual

3. Use:

SOH Volume 5 provides a detailed user's Operations and Maintenance Manual for the GOES-R Flight OBC.

4. Preparation Information:

Electronic format of SOH volumes **shall** have ability to hyperlink to other SOH Volumes and other contractor supplied operations documents.

SOH Volume 5 **shall** provide the following OBC information:

1) Overview of basic OBC performance specifications
2) Functional block diagrams of interfaces with all other satellite subsystems.
3) Detailed description of basic OBC operations, including initialization, redundancy switching and diagnostic capabilities.
4) Detailed description of procedures for OBC operation, including table loads, memory read-out, and routine flight software management.
5) Include a Hyperlink to the Software Maintenance Manual.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-MNGT-06	SOH Volume 6 –GOES R/S/T/TBD Spacecraft Specific Data

3. Use:

SOH Volume 6 provides spacecraft unique data for the GOES-R spacecraft, Volume 7 for the GOES-S spacecraft, and Volume 8 for the GOES-T spacecraft.

4. Preparation Information:

Electronic format of SOH volumes **shall** have ability to hyperlink to other SOH Volumes and other contractor supplied operations documents.

Provide all data needed to assess the health and safety of this specific satellite. The contractor **shall** update this document as required throughout the mission. Required data **shall** include:

1) Calibration Curves -Calibration data used by the ground system to convert satellite telemetry into accurate engineering values. Includes both analog and digital telemetry from the spacecraft bus and instrument engineering telemetry derived from the wideband (raw data) stream.

2) Telemetry Limits -Three type of limits **shall** be provided. Red Limits, Yellow Limits, and Design/Operations Limits. Red limits are the values above or below which the operator must take action to prevent possible damage of the component. Yellow limits are defined to indicate a precursor to Red Limits. Design/Operations limits are the values which the component maintains throughout the nominal mission.

3) Mass Properties -Sequenced list of center of mass, moments and products of inertia for every possible mission configurations and phase, including before and after each deployment, ascent maneuver, on station, and end of life conditions.

4) Power -Measured power for each unit, power budget summary including load uncertainty, predicted solar array output, and predicted battery charge performance over the mission life.

5) Communications Link Margins -Bandpass response, output power and frequency for all transmitters, frequency ratios for all transponders, and sensitivity thresholds for all receivers. Include antenna patterns.

6) Sensor/Actuator Alignment Data -Forces and torques which correspond to the motion of the spacecraft center of mass. Impingement of thrusters on spacecraft components. Solar induced torque predictions. Alignment data of all sensors and actuators.

7) Deployable Torque Margins -Available torque, required torque, and remaining torque for all deployables.

8) Propulsion -Thruster performance, including thrust, specific impulse, mixture ratios, flow rates, and efficiencies. Thermal ramifications of long duration burns. Include any special parameters of electric thrusters.

Effective Date: (Date of last signature)

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-MECH-01	Fields-of-View (FOV) Analysis Report

3. Use:

To support the optimization of the overall spacecraft configuration and to assure compliance with the FOV requirements of all spacecraft sensors and GFP instruments.

4. Preparation Information:

The FOV Analysis Report **shall** document a complete fields-of-view (FOV) analysis of each instrument and sensor.

The FOV Analysis Report **shall** include:

1) Derivation of the optimized configuration, location, and compatibility for each instrument, spacecraft sensor, solar array, exhaust plume.

2) The functional requirements compared to the design.

3) FOV tolerances and errors.

4) Detailed quantitative descriptions of all objects within the fields-of-view.

5) Analysis of blockage disturbances and reflections including sun glint.

The FOV Analysis Report **shall** include trade-offs conducted for the optimization of the spacecraft configuration.

The FOV Analysis Report revisions **shall** reflect test, measurement, and configuration changes.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: SC-MECH-02

2. Title: Solid Model

3. Use:

Government will use for independent verification of constraints and field of view requirements.

4. Preparation Information:

Solid Model **shall** be delivered in its native, STEP and lightweight formats.

Solid Model **shall** include both stowed and deployed configurations.

Solid Models **shall** be validated for geometric accuracy and integrity.

The lightweight format for the Solid Model **shall** be eDrawings by Solid Works Corp., Lattice 3D XVL by Lattice Technology, or similar product.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-MECH-03	Critical Mechanical Clearance List and Model

3. Use:

This document is used to identify and track critical clearances in the spacecraft design including spacecraft to launch vehicle fairing and deployable paths.

4. Preparation Information:

The Critical Mechanical Clearance List and Model **shall** include minimum clearances, under normal and worst case conditions, between any moving mechanical assembly or deployable, and any other hardware, including structure, components, thermal control materials, cabling, harness.

The analysis results used in the Critical Mechanical Clearance List and Model **shall** include the effects of environments on the structure including gravity release and thermal distortions.

The Critical Mechanical Clearance List and Model **shall** address the mitigations taken to prevent mechanisms from hanging.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: SC-MECH-04

2. Title: Alignment Plan

3. Use:

This plan establishes alignment budgets for Spacecraft components and integration of GFP instruments with the spacecraft bus, and an implementation plan at all levels of assembly and test.

4. Preparation Information:

The Alignment Plan **shall** be a spacecraft-level document that describes the budgets assigned for structure including secondary structure, GN&C sensor module, and instruments.

The Alignment Plan **shall** list all alignments and the tolerances for spacecraft components and GFP instrument interfaces.

The Alignment Plan **shall** list all tooling and alignment methods required to meet critical and non-critical alignments.

The Alignment Plan **shall** specify sign convention for positive and negative angles.

The Alignment Plan **shall** describe a fail-safe method to avoid sign errors.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
SC-MECH-05	Alignment Report

3. Use:

For establishing compliance with alignment requirements. The actual alignment values after mechanical integration of various components are listed here. The actual alignment values will then be used by the spacecraft GN&C team to assess GN&C performance and to list in the Spacecraft Operations Handbook.

4. Preparation Information:

The Alignment Report **shall** list all achieved alignment values and the corresponding specifications for all spacecraft components and GFP instrument interfaces.

The Alignment Report **shall** clearly state the sign convention for positive and negative angles.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: **2. Title:**

SC-MECH-06 Stress Analysis Reports

3. Use:

To document the margins of safety calculations for all structural elements in the spacecraft.

4. Preparation Information:

The Stress Analysis Reports **shall** include detailed stress analyses and margin of safety calculations for all components of the spacecraft.

The stress information in the Stress Analysis Reports **shall** be summarized in tabular form, providing a description of each structural element, its critical loading conditions, including thermal and mechanisms loading, failure modes, margins of safety, and reference to detailed analyses.

The Stress Analysis Reports **shall** identify primary load-paths and all simplifying assumptions clearly stated.

The final Stress Analysis Reports **shall** document and include any additional finite elements models developed for use in analyzing structural components.

The Stress Analysis Reports **shall** describe any parametric studies undertaken to minimize component loads.

The Stress Analysis Reports **shall** describe the structural requirements including flight loads, mode shapes frequencies, mass properties, stresses, deformations and information defining the structural materials such as alloy type, strength, heat treatment, hardness, chemical treatment, finish and other physical properties that have an influence on structural analysis.

The Stress Analysis Reports **shall** present the structural requirements of the launch vehicle that are related to the spacecraft.

The final version of the Stress Analysis Reports **shall** incorporate the results of the test verified flight loads analysis, where such changes are necessary because of loads that exceeded previously predicted levels.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-MECH-07	Structural and Mechanical Subsystem Performance Analysis Report

3. Use:

To document the analyses and data demonstrating that all structural and mechanical subsystem performance requirements are satisfied.

4. Preparation Information:

For each spacecraft configuration, the Structural and Mechanical Subsystem Performance Analysis Report **shall** contain the following:

1) Design limit loads:

    a. This report **shall** define the spacecraft design limit loads.

    b. This report **shall** describe the philosophy used in the derivation of the design limit loads.

    c. This report **shall** document the factors of safety and uncertainty factors applied to or utilized in the development of the design limit loads.

2) Flight loads analyses:

    a. This report **shall** document the spacecraft and GFP instrument flight loads analysis data and results, for each flight loads analysis performed either by the spacecraft contractor or by the launch vehicle contractor.

    b. This report **shall** identify primary load paths and state all assumptions used.

    c. This report **shall** document the analyses, tests and test data required to verify all spacecraft alignment and stiffness requirements.

    d. This report **shall** address spacecraft mechanical design verification with respect to dynamic interactions with the launch vehicle and GFP instruments.

3) Spacecraft clearances:

    a. This report **shall** document all spacecraft critical clearances and loss of clearances, with the associated analyses.

    b. This report **shall** include dynamic loss of clearance between the spacecraft including GFP instruments and the launch vehicle, and between various spacecraft elements.

    c. This report **shall** document the predicted clearance loss for critical clearances throughout all mission phases, including launch, on-orbit deployments and on-orbit operations.

    d. The report **shall** document the components contributing to each clearance loss including manufacturing and assembly tolerances, spacecraft dynamics and thermal gradients, spacecraft insulation, harnesses and grounding provisions.

e. The report **shall** document the analytical and measured data used for clearance verification.

4) Mechanical performance:

a. This report **shall** document the tests and analyses performed to verify the performance of the spacecraft mechanisms and deployment devices.

b. This report **shall** document the analyses and test data used to verify the spacecraft structural performance and workmanship.

c. This report **shall** also address any methods utilized during fabrication and assembly which verify workmanship of the spacecraft structure and mechanical components.

5) Force and/or Torque Margin Analysis:

a. This report **shall** document force and/or torque margin analysis and test data for all spacecraft deployables and mechanisms.

6) On-Orbit Thermal Distortion:

a. This report **shall** provide INR performance analysis data from on-orbit thermal distortion analysis.

For the submittal at the subsystem PDR, the Structural and Mechanical Subsystem Performance Analysis Report **shall** include:

- Dynamic load requirement flow chart.
- Summary of the models/analyses used to determine the mechanical behavior of the structure.
- Spacecraft stiffness requirements.
- Summary of the validation test performed or planned to correlate the model.
- Design loads tables.
- Alignment budget (preliminary).
- Dynamic loss of clearance.
- Comparison of requirements against analysis results.
- Description of in-process testing requirements (proofload of bonded joints).

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-MECH-08	Structural Math Models and Report

3. Use:

The government will use the models to predict structural accelerations, deflections, internal loads and on-orbit dynamic analysis.

The launch vehicle contractor will use the reduced order structural math model in a coupled loads analysis to predict the spacecraft flight loads.

4. Preparation Information:

The Structural Math Models and Report **shall** represent the spacecraft in its launch and operational configurations including all the integrated science instruments.

The Structural Math Models and Report **shall** include full and reduced order models for each configuration.

The launch configured reduced order model in the Structural Math Models and Report **shall** be a Craig-Bampton reduction transformation of the full order model including modes to 100 Hz.

The on orbit configured model in the Structural Math Models and Report **shall** be a modal transformation of the full order model including modes to 500 Hz.

The on orbit model in the Structural Math Models and Report **shall** include time histories of the operational forces and torques including the reaction wheels, thrusters and solar array stepping.

The full order models in the Structural Math Models and Report **shall** be MSC/NASTRAN compatible.

The models in the Structural Math Models and Report **shall** be in SI units.

The final models in the Structural Math Models and Report **shall** be correlated to modal survey data.

The reduced order models in the Structural Math Models and Report **shall** include load transformation matrices (LTMs).

The LTMs in the Structural Math Models and Report **shall**:

1) Consist of influence coefficients relating selected output variables to the associated dynamics model response variable,
2) Include launch vehicle to spacecraft interface reaction forces, component to spacecraft interface reaction forces, and reaction forces at support locations for deployables,
3) Include spacecraft net acceleration loads at the spacecraft center of mass,
4) Include force, shear, and moment coefficients for determining internal loads in critical structural members,
5) Include coefficients for determining absolute and relative deflections of spacecraft internal elements,
6) Include instrument net acceleration loads at the instrument center of mass,
7) Include discrete instrument interface accelerations and forces, and

8) Include boundary acceleration effects.

The Structural Math Models and Report **shall** document the math models with the following information:

1) Configuration version
2) Identification of the documents and drawings used to generate the model
3) Model mass properties
4) Boundary conditions
5) Figures showing the components modeled
6) References used for the mechanical properties
7) Summary of output results including modal frequencies, deflections and critical stresses
8) Un-deformed and deformed plots of the FEM
9) Any parametric studies undertaken to minimize component loads
10) Output and input rows and columns of the LTMs

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: **2. Title:**

SC-MECH-09 Mechanisms Performance Analysis Report

3. Use:

This data is used by NASA to determine that the GOES-R mechanisms subsystem design satisfies all performance requirements.

4. Preparation Information:

The Mechanisms Performance Analysis Report **shall**:

1. Consist of block diagrams, analyses, and computer simulations of all electromechanical and deployable mechanisms and control systems to demonstrate compliance with the design and performance requirements.
2. Consist of a mechanisms requirements compliance matrix identifying the demonstration method for each requirement.
3. Document analytical and measured gain and phase margins.
4. Document analysis and test data for force and torque margins.
5. Document predicted and measured dynamic disturbances generated by all moving components.
6. Describe the sensors and the sensor telemetry available for diagnosing and assessing the dynamic behavior of the spacecraft on-orbit.
7. Contain results from timing margin analysis of the asynchronous circuitry used in control systems.
8. Contain results from worst case and end of life performance analyses.
9. Contain life test plans for components with bearings, flexible mounts, or flexible harnessing.

All supporting analysis, simulations, and/or databases for the Mechanisms Performance Analysis Report **shall** be available for review at the contractor's facilities.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: **2. Title:**

SC-MECH-10 Mass Properties Report

3. Use:

To document all physical mass properties of the spacecraft, its subsystems and components from preliminary design through final assembly, launch and throughout all phases of the mission up to End of Life (EOL).

4. Preparation Information:

The coordinate system used in this Mass Properties Report **shall** be in accordance with the Society of Allied Weight Engineers (SAWE) Recommended Practice No. 6. [1]

This Mass Properties Report **shall** be in accordance with the requirements of the Society of Allied Weight Engineers (SAWE) Recommended Practice (RP) No. 11 sections 5.3.3 and 5.3.4. [2]

This Mass Properties Report **shall** provide a mass properties database for each spacecraft including the GFP instruments.

The Mass Properties Report **shall** include mass, center of gravity, moments of inertia and products of inertia.

The Mass Properties Report **shall** be based upon calculated values and **shall** be updated as calculations are revised and actual measured data becomes available.

Following environmental testing and prior to the spacecraft shipment, the Mass Properties Report **shall** contain a complete mass properties summary of the final spacecraft mass properties as measured.

The Mass Properties Report **shall** include the appropriate mass contingency for the current stage of hardware development, along with the allocated mass allowable.

The Mass Properties Report **shall** include the following:

1) An overall spacecraft mass summary, including total spacecraft dry mass, spacecraft subsystem dry mass, total spacecraft launch mass (including propellant), total spacecraft orbit insertion mass, and spacecraft mass at EOL
2) A spacecraft mass properties summary for the various phases of the mission, including launch, deployments, separation, through EOL. This summary **shall** also demonstrate mass changes due to propellant utilization throughout the mission through EOL
3) A detailed mass properties summary of all spacecraft hardware organized by subsystem
4) A summary of all mass properties changes incorporated into the spacecraft mass properties database since the last report.

References:

1. “Standard Coordinate Systems for Reporting the Mass Properties of Flight Vehicles; Recommended Practice No. 6”, Revised 1 September 1999, Society of Allied Weight Engineers, Los Angeles, 3 January 1995.
2. “Mass Properties Control for Space Vehicles; Recommended Practice No. 11”, Rev. B, Society of Allied

Effective Date: (Date of last signature)

Weight Engineers, Los Angeles, 3 June 2000.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:

SC-THER-01

2. Title:

Reduced Integrated Satellite Thermal Model

3. Use:

The reduced spacecraft thermal model and the reduced instrument models will be combined into a Reduced Integrated Satellite Thermal Model to represent GOES-R.

The Reduced Integrated Satellite Thermal Model will be delivered to the government and then transferred to each of the instrument vendors for their use.

Instrument contractors will employ the Reduced Integrated Satellite Thermal Model to independently verify the thermal interface between the spacecraft and the instruments.

The Reduced Integrated Satellite Thermal Model in launch configuration will be delivered to the launch vehicle provider via the government for assessing Spacecraft, Instrument and Launch Vehicle safety concerns.

After delivery to the government, the Reduced Integrated Satellite Thermal Model is expected to be exercised by various parties throughout the GOES-R mission life.

The spacecraft contractor will maintain the official GOES R Reduced Integrated Satellite Thermal Model.

4. Preparation Information:

The accompanying Reduced Integrated Satellite Thermal Model documentation **shall** include sample run results to enable model users to reproduce proper temperature and heater power results.

The accompanying Reduced Integrated Satellite Thermal Model documentation **shall** include tabular and textual descriptions of parts of the models that might otherwise be misunderstood.

The reduced spacecraft thermal model **shall** include a geometric math model (GMM), which calculates radiation couplings and environmental heat fluxes, and a thermal math model (TMM), or nodal models that calculates the heat transfer and resultant temperatures.

The reduced spacecraft thermal model **shall** be an accurate geometric representation of the spacecraft physical configuration in order to produce/predict adequate spacecraft thermal performance during all phases of the mission from pre-launch through mission EOL.

The reduced instrument thermal models (furnished by the government) **shall** be incorporated/integrated with the reduced spacecraft thermal model to form the reduced integrated satellite thermal model.

The reduced spacecraft GMM **shall** contain between 200 and 1000 surfaces. The reduced spacecraft TMM **shall** contain between 200 and 500 nodes. These nodal and surface limitations do not include the GFP supplied instruments.

The reduced spacecraft model **shall** employ a unique numbering system, which applies to node numbers, conductor numbers, array numbers, and user constants. The numbering system for the spacecraft **shall** be as follows: 0 to 29,999 reserved for the spacecraft model; 99,990 to 99,998 reserved for radiation junk nodes; 99,999 reserved for the space node.

GMMs **shall** be in Thermal Desktop format.

TMMs **shall** be in The Systems Improved Numerical Differencing Analyzer 85 (SINDA85) format.

The Reduced Integrated Satellite Thermal Model submissions **shall** have the GMM and TMM embedded in a Thermal Desktop (TD) format.

The Reduced Integrated Satellite Thermal Model **shall** use units of millimeters for length, seconds for time, Watts for energy, and Celsius for temperature.

The Reduced Integrated Satellite Thermal Model **shall** support both steady-state and transient solutions.

The Reduced Integrated Satellite Thermal Model **shall** represent all flight environments and mission modes from pre-launch through the entire mission life, as well as the environments of the thermal balance and thermal vacuum tests. Cases **shall** include, but not be limited to, operation and storage in geosynchronous orbit during

1) Winter solstice (or hot case) ,
2) Summer solstice,
3) Equinox/eclipse (or cold case),
4) Solar declinations of 8.7° north and 8.7° south
5) And other cases which stress elements of the thermal control system or those required to validate either the spacecraft or instrument designs
6) plus
7) Launch and ascent (not required prior to PDR),
8) Transfer orbit (not required prior to PDR).

Thermal models **shall** employ the concurrent worst case biasing of variables including:

1) Beginning-of-life (BOL) and end-of-life (EOL),
2) Coatings thermal optical properties,
3) Heat dissipations,
4) Conductances,
5) Interface conductances,
6) Environmental inputs (solar, earth IR, albedo),
7) Insulation effectiveness,

8) Active system operating parameters, etc.

The range of these variables **shall** include allowance for natural variations, measurement uncertainties, manufacturing and assembly tolerances, degradation over the mission life, and contamination.

All software code for any custom analytical subroutines **shall** be submitted with the subroutine.

Apertures, radiators, and other surfaces of special interest **shall** be modeled (nodalyzed) individually.

Every dissipating component, assembly and subassembly **shall** be a node that represents its temperature prediction.

Every flight temperature sensor **shall** be a node that represents its temperature prediction.

Every satellite surface within the FOV of instrument apertures or radiators **shall** be represented by a GMM surface and TMM node that represents its temperature prediction

Geometry and coatings properties **shall** be traceable to the physical reality of the spacecraft hardware.

The reduced integrated satellite thermal model **shall** represent all spacecraft/instrument configurations that require analysis; for example, launch configuration with optical cover closed and science configuration with optical cover open.

The launch configuration version of the reduced integrated satellite thermal model which includes convection effects **shall** be developed by CDR and maintained thereafter.

The reduced integrated satellite thermal model nodes or surfaces using adiabatic surfaces or arithmetic nodes (zero mass nodes) **shall** be noted in accompanying model documentation.

All spacecraft sub model names, optical & thermophysical properties, TD symbols, and component names **shall** have the prefix “SC”.

All file names **shall** be representative of their appropriate analysis case; files include but are not limited to the SINDA input file and radk, heatrate, and output files.

The Reduced Integrated Satellite Thermal Model accompanying documentation **shall** include a listing of all included GMM and TMM files, including filename, description, and format (Thermal Desktop, SINDA).

The accompanying model documentation **shall** include results of two sample runs: worst EOL hot case and worst BOL cold case. These sample cases include stacking of variables as noted in this document.

The accompanying model documentation **shall** include a tabular listing of min/max temperature predictions and allowable operating and non-operating MAT limits for all nodes.

The accompanying model documentation **shall** delineate each heater’s power consumption for the sample cases.

The Reduced Integrated Satellite Thermal Model **shall** be correlated against the system level thermal balance test data

The Reduced Integrated Satellite Thermal Model **shall** be correlated with the thermal balance test data to temperatures within 3C and unit energy balance within 3 %.

Effective Date: (Date of last signature)

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: SC-THER-02

2. Title: Reduced Integrated Satellite Thermal Model Report

3. Use:

This report facilitates the transfer, use and future suggestions of potential modifications of the reduced integrated satellite thermal model by the government and/or participating government contractors.

4. Preparation Information:

The Reduced Integrated Satellite Thermal Model Report **shall** demonstrate the credibility of the model by reviewing the details of the model correlation activities.

The Reduced Integrated Satellite Thermal Model Report **shall** state the version/date of the reduced integrated satellite thermal model being discussed and should also state the version/date of the reduced spaceraft model and reduced instrument models included in the reduced satellite model.

The TMM and GMM upon which the Reduced Integrated Satellite Thermal Model Report is based and any required accompanying information and sample run results **shall** be submitted with this report.

The TMM **shall** include sketches/figures showing the overall layout of the satellite with dimensions and with significant features of the spacecraft and instrument thermal control systems identified (e.g., radiators, insulation, apertures).

The TMM **shall** include figures or sketches showing how nodes and surfaces correspond to components.

The Reduced Integrated Satellite Thermal Model Report **shall** include tables delineating:

1) Node or surface number (can group as appropriate),
2) Node or surface brief description,
3) Node area (mm2),
4) Predominant materials,
5) Predominant surface finishes,
6) Electrical dissipation range for operating, non-operating and for other modes.

The Reduced Integrated Satellite Thermal Model Report **shall** include:

1) Heater power dissipation range for all operating and non-operating modes including the bus voltage variations,
2) Type of control for each heater (i.e., on/off ground command, thermostatic or proportional),
3) The node used for heater control,

4) Rated power at spacecraft voltage for each heater, and

5) The designator and relationship of the closest representative flight temperature sensors.

The Reduced Integrated Satellite Thermal Model Report **shall** present power profiles of varying dissipations and explain when they apply.

The Reduced Integrated Satellite Thermal Model Report **shall** include a table listing all thermal control coatings (BOL & EOL values) referenced to model surface finish designators.

Transient plots of special interest **shall** be provided in the the Reduced Integrated Satellite Thermal Model Report.

The Reduced Integrated Satellite Thermal Model Report **shall** describe GMM and TMM variations that represent the various spacecraft/satellite configurations such as aperture open/closed, solar array stowed/deployed.

The Reduced Integrated Satellite Thermal Model Report **shall** note the surfaces/nodes that had to be deleted from the reduced spacecraft model and reduced instrument models to produce the reduced integrated satellite thermal model.

The Reduced Integrated Satellite Thermal Model Report **shall** document the model correlation activity and **shall** incorporate applicable test data and flight data to refine and correlate the model.

Prior to CDR, after system level thermal balance testing and prior to flight the reduced integrated satellite thermal model **shall** be correlated against the detailed integrated satellite thermal model.

The correlation **shall** include at least the following cases; a hot operating EOL case, a cold operating BOL case, a transient eclipse case and a cold storage case.

The Reduced Integrated Satellite Thermal Model Report **shall** include a summary of the spacecraft and instrument back loading to each instrument and summarizing the radiative and conductance heat transfer from instrument to instrument and spacecraft to instrument.

The Reduced Integrated Satellite Thermal Model Report **shall** include a discussion of the correlation of the reduced and detailed satellite thermal models and documenting that the corresponding temperatures agree within 2C and heater power within 3% for any set of boundary conditions.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: **2. Title:**

SC-THER-03 Detailed Integrated Satellite Thermal Model

3. Use:

The detailed spacecraft thermal model and the reduced Instrument thermal models will be combined to obtain a Detailed Integrated Satellite Thermal Model to represent GOES-R .

4. Preparation Information:

This Detailed Integrated Satellite Thermal Model **shall** be used to demonstrate the adequacy of the thermal design to meet the temperature, temperature gradient and heater power requirements, both explicit and derived, under worst-case hot and cold environments for all mission phases and operating modes.

This Detailed Integrated Satellite Thermal Model **shall** be used to verify all thermal interface (ICD) requirements between the spacecraft and the instruments.

This Detailed Integrated Satellite Thermal Model **shall** be delivered to the government and will be subject to inspection.

The Detailed Integrated Satellite Thermal Model **shall** include a geometric math model (GMM), which calculates radiation couplings and environmental heat fluxes, and a thermal math model (TMM), or nodal models that calculates the heat transfer and resultant temperatures.

The Detailed Integrated Satellite Thermal Model **shall** be of adequate detail to demonstrate achievement of all defined requirements for temperature, temperature gradients and heater power.

The detailed Spacecraft thermal model **shall** be an accurate geometric representation of the spacecraft physical configuration in order to produce/predict adequate spacecraft thermal performance during all phases of the mission, from pre-launch through EOL.

The reduced Instrument thermal models (furnished by the government) **shall** be incorporated with the detailed Spacecraft thermal model to form a detailed integrated satellite thermal model.

The Detailed Integrated Satellite Thermal Model **shall** employ a unique numbering system, which applies to node numbers, conductor numbers, array numbers, and user constants. The numbering system for the spacecraft **shall** be as follows: 0 to 29,999 reserved for the spacecraft model; 99,990 to 99,998 reserved for radiation junk nodes; 99,999 reserved for the space node.

GMMs **shall** be in Thermal Desktop format.

TMMs **shall** be in The Systems Improved Numerical Differencing Analyzer 85 (SINDA85) format.

The Detailed Integrated Satellite Thermal Model submissions **shall** have the GMM and TMM embedded in a Thermal Desktop (TD) format.

The Detailed Integrated Satellite Thermal Model **shall** use units of millimeters for length, seconds for time, Watts for energy, and Celsius for temperature.

The Detailed Integrated Satellite Thermal Model **shall** support both steady-state and transient solutions.

The Detailed Integrated Satellite Thermal Model **shall** represent all flight environments and mission modes from pre-launch through the entire mission life, as well as the environments of the thermal balance and thermal vacuum tests.

Analysis cases in the Detailed Integrated Satellite Thermal Model **shall** include, but not be limited to, operation and storage in geosynchronous orbit during

1) Winter solstice (or hot case),

2) Summer solstice,

3) Equinox/eclipse (or cold case),

4) Solar declinations of 8.7° north and 8.7° south

5) Other cases which stress elements of the thermal control system or those required to fully validate either the spacecraft and/or instrument designs.

The thermal Models in the the Detailed Integrated Satellite Thermal Model **shall** employ worst case biasing of variables including:

1) Beginning-of-life (BOL) and end-of-life (EOL),coatings thermal optical properties,

2) Heat dissipations,

3) Conductances,

4) Interface conductances,

5) Environmental inputs (solar, earth IR, albedo),

6) Insulation effectiveness,

7) Active system operating parameters, etc.

The range of these variables **shall** include allowance for natural variations, measurement uncertainties, manufacturing and assembly tolerances, degradation over the mission life, and contamination.

All software code for any custom analytical subroutines **shall** be submitted with the subroutine.

Apertures, radiators, and other surfaces of special interest **shall** be modeled (nodalized) individually.

Every component, assembly and subassembly **shall** be represented by a node that represents its temperature prediction.

Every flight temperature sensor **shall** be a node that represents its temperature prediction.

Effective Date: (Date of last signature)

Every satellite surface within the FOV of instrument apertures or radiators **shall** be a GMM surface and TMM node that represents its temperature prediction.

Geometry and coatings properties **shall** be traceable to the physical reality of the satellite hardware.

The Detailed Integrated Satellite Thermal Model **shall** represent all spacecraft/instrument configurations that require analysis; for example, launch configuration with optical cover closed and science configuration with optical cover open.

The Detailed Integrated Satellite Thermal Model nodes or surfaces considered adiabatic or arithmetic (zero mass nodes) **shall** be noted in accompanying model documentation.

All spacecraft sub model names, optical & thermophysical properties, TD symbols, and component names **shall** have the prefix “SC”.

All file names **shall** be representative of their appropriate analysis case; files include but are not limited to the SINDA input file and radk, heatrate, and output files.

The Detailed Integrated Satellite Thermal Model accompanying documentation **shall** include a listing of all included GMM and TMM files, including filename, description, and format (Thermal Desktop, SINDA).

TMM nodes not represented in the GMM **shall** have the following information listed in the accompanying model documentation broken down by node: node number, description, dissipation, properties.

The accompanying model documentation with the Detailed Integrated Satellite Thermal Model **shall** include results of two sample runs: worst hot EOL case and worst cold BOL case. These sample cases include stacking of variables as noted in this document.

The accompanying model documentation with the Detailed Integrated Satellite Thermal Model **shall** include a tabular listing of min/max temperature predictions and allowable operating and non-operating MAT limits for all nodes.

The accompanying model documentation with the Detailed Integrated Satellite Thermal Model **shall** delineate each heater’s power consumption for the sample cases.

The Detailed Integrated Satellite Thermal Model **shall** be correlated against system level TB test results.

The Detailed Integrated Satellite Thermal Model **shall** correlate with test data to within 3°C in temperature and to within 3% in unit energy balance.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-THER-04	Thermal Subsystem and Performance Report

3. Use:

Evaluate the adequacy of the thermal design to meet requirements, both explicit and derived, under worst case hot and cold environments for all mission phases and operating modes.

4. Preparation Information:

Thermal Subsystem and Performance Report **shall** include a complete tabular list of the operating and non-operating Qualification, Protoflight, Acceptance and Mission Allowable Temperatures (MATs) for the Spacecraft and Instrument components referenced to thermal model node numbers.

Thermal Subsystem and Performance Report **shall** include Spacecraft and Instrument component temperature predictions from the reduced and detailed integrated satellite thermal models and compared to their operating and non-operating Mission Allowable Temperatures, noting temperature margins.

Thermal Subsystem and Performance Report **shall** include Spacecraft and Instrument component heater power predictions for the same cases as in item B compared to their heater capability, noting heater power margins.

The following flight cases **shall** be used for Band C: Summer solstice, Winter solstice, N 8.7 º, S 8.7º, Equinox Equinox eclipse, launch/ascent, orbit storage and any other thermally significant Spacecraft or Instrument condition for all satellite operating modes

Thermal Subsystem and Performance Report **shall** include temperature and heater power predictions for the wetted portions of the propulsion system as a function of time of year and satellite operating mode.

Thermal Subsystem and Performance Report **shall** include all thermal engineering assumptions and parameters (i.e., detailed power distribution breakdown, solar absorptances, emittances, solar and Earth's albedo inputs) that are used in the thermal analyses.

Thermal Subsystem and Performance Report **shall** address uncertainties and/or margins included in the temperature predictions and a detailed description of how they were determined.

Thermal Subsystem and Performance Report **shall** describe all flight thermal sensors and their locations on the satellite including drawings depicting their locations.

Thermal Subsystem and Performance Report **shall** describe all flight heaters, their power capability, control, locations and present drawings depicting their locations.

Thermal Subsystem and Performance Report **shall** incorporate applicable test data and flight data to substantiate requirement compliance.

Thermal Subsystem and Performance Report **shall** use temperature and heater power predictions from B and C to substantiate and delineate compliance with the GOES R temperature, temperature gradient and heater power requirements.

Effective Date: (Date of last signature)

Thermal Subsystem and Performance Report **shall** use the temperature predictions from B to substantiate and delineate compliance with interface temperature requirements.

Thermal Subsystem and Performance Report **shall** use the results from the analyses in C to substantiate and delineate compliance with heat flux and back loading requirements.

Thermal Subsystem and Performance Report **shall** be updated with flight data after one year in orbit.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: SC-THER-05

2. Title: Thermal Environment for GFP Instruments

3. Use:

This document describes the on-orbit thermal environment for the individual GFP Instruments.

This information permits stand-alone instrument models to predict thermal performance when integrated to the GOES-R satellite.

To restrict proprietary and competitive information flow between instrument contractors, the spacecraft contractor will provide and maintain variant(s) of the Satellite Reduced Thermal Models. Instrument vendors intent on concealing design information (from competitors) may provide instrument thermal models with accurate external information but devoid of internal details, called shell models. The spacecraft contractor will incorporate these shell models replacing the instrument reduced models. Each instrument vendor **shall** be supplied model variants with competitors shell models.

4. Preparation Information:

A separate Thermal Environment **shall** be delivered for each GFP instrument.

Thermal Environment for GFP Instruments **shall** be based upon and delivered with an up-to-date Satellite Reduced Thermal Model.

The Satellite Reduced Thermal Model **shall** be consistent with specifications listed in DID SC-THER-01.

The model sample runs **shall** include the expected worst hot and cold cases for this particular GFP instrument, as well as survival and launch/ascent/transfer orbit cases.

Thermal Environment for GFP Instruments **shall** present:

1) Orbit parameters for the bounding cases
2) Thermal flux parameters (e.g. Solar)
3) Thermal optical properties for satellite surfaces (absorptance, emittance, specularity)
4) The date and version designators for the GFP models
5) Satellite temperature summary for all sample run cases listed above, compared against temperature requirements

Thermal Environment for GFP Instruments **shall** include figures showing at least the overall layout of the satellite, including internal and external spacecraft details.

Dimensions and significant features of the thermal control system in the Thermal Environment for GFP Instruments **shall** be identified in the figures (e.g., radiators, insulation, apertures).

Thermal Math Models in the Thermal Environment for GFP Instruments **shall** include figures or sketches showing how nodes and surfaces correspond to satellite components.

The report **shall** note the surfaces/nodes that must be deleted by the instrument integrator during model integration.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u> | **2. <u>Title:</u>**

SC-GN&C-01 | GN&C Detail Description

3. <u>Use:</u>

This document provides a detailed description of the GN&C and its interfaces with the other spacecraft subsystems. The information will be used to understand the GN&C design, evaluate anomalies encountered during the GN&C and spacecraft level tests, and provide operations personnel with the necessary understanding of the operational capabilities and constraints associated with the GN&C.

4. <u>Preparation Information:</u>

The GN&C Detail Description **shall** provide the following information:

1) Definition of all firmware/software associated with the GN&C, including that resident in any computer/processor internal or external to the GN&C (includes all applicable code and flow diagrams).
2) Detailed block diagrams and electrical schematics of all GN&C equipment.
3) Detailed descriptions and performance characteristics of all attitude sensors and control actuators, including processing and drive electronics.
4) Definition of interfaces with other satellite subsystems and payload instruments.
5) Definition of all GN&C command and telemetry functions, including units and telemetry sample rates.
6) Other documentation necessary to operate and/or diagnose anomalous GN&C performance.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-GN&C-02	GN&C Algorithm Document

3. Use:

To fully describe all the GN&C algorithms that will be used and coded in flight software.

1) This document provides intermediary information that the flight software personnel can use to write the flight code from the GN&C specification and other subsystem information, where the specification or subsystem information is too high-level or esoteric to permit easy coding by programmers not familiar with subsystem design and operation.
2) This document can be used by the mission operations flight team to maintain the GN&C flight software in the advent of an anomaly.

4. Preparation Information:

The GN&C Algorithm Document shall describe the GN&C algorithms with sufficient detail to be useful to software engineers, design engineers, subsystem, systems engineers and the flight operations team.

The GN&C Algorithm Document **shall**:

1) Include textual descriptions of each algorithm and diagrams such as mode-transition diagrams data flow diagrams, structure charts and control diagrams.
2) Describe each algorithm in terms of inputs, outputs, and processing.
3) Define software interfaces and internal variables, execution rates, deadlines, operational constraints and restrictions.
4) Define the units of all software constants and variables.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u> **2. <u>Title:</u>**

SC-GN&C-03 GN&C Sensor Models

3. <u>Use:</u>

Attitude determination performance is simulated using models of the inertial reference unit (gyros) and star trackers. Since these models are critical to attitude determination performance they will have a direct impact on INR, insight is required for use in the projects in-house Matlab/Simulink analysis tools.

4. <u>Preparation Information:</u>

The GN&C Sensor Models **shall** contain the high fidelity analytical model of the inertial reference unit (gyros) that is used to simulate attitude determination performance.

The GN&C Sensor Models **shall** contain the high fidelity analytical model of the star tracker that it used to simulate attitude determination performance.

For each GN&C Sensor Model:

1) The delivery **shall** be in Matlab/Simulink.

2) The code **shall** be fully commented including definitions of all inputs, outputs, constants and variables. Units of each parameter **shall** be defined.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: **2. Title:**

SC-GN&C-04 GN&C Performance Analysis Report

3. Use:

To provide documentation that verifies that the GN&C design will satisfy all requirements and will successfully support all relevant mission objectives.

4. Preparation Information:

The GN&C Performance Analysis Report **shall** include analyses, simulations, and test data to verify that the GN&C design satisfies all relevant requirements.

The GN&C Performance Analysis Report **shall** include the following:

1) GN&C requirements compliance matrix, showing how each subsystem-level requirement was verified.
2) Instrument interface error budgets to show all contributions to and compliance with INR and GN&C GN&C related requirements of all nadir and solar pointed instruments. Description and justification of the method of combining errors. For each error source, provide:
   a) Error magnitude and basis of estimate
   b) Frequency content
   c) Whether the error will be observable and separable on-orbit and if not what combination of ground testing, analysis, and indirect on-orbit measurements demonstrate that the source is within its allocation.
3) GN&C component and subsystem alignment including:
   a) Definition of all relevant coordinate frames, and identification of the master reference frame
   b) Alignment measurement method and accuracy
   c) Measured alignment matrices
4) GN&C analyses and simulations. For each GN&C mode, provide the following:
   a) Description of mode, including derived requirements, transitions into and out of the mode, block diagram showing transfer functions for all hardware and software components.
   b) Analyses and simulations that verify that the mode meets all derived functional and performance requirements. This includes verification of system performance in response to internal and external disturbance torques, and uncompensated momentum.
   c) Rigid and flexible-body stability margins for each hardware signal path yielding a unique open-loop transfer function.
   d) Sensitivity analysis and/or simulations for key parameters.
5) Definition, analyses, and simulations of the momentum management system.
6) Definition of GN&C Fault Detection and Correction, including a list of faults detected on-board and the corresponding on-board and ground actions. Analysis and simulations demonstrating system behavior in failure scenarios, with both detected and undetected faults.
7) Analyses and simulations of solar array pointing and control functions, including definition of disturbances generated by the drive system and the flexible characteristics of the solar array.
8) Define all test points required to support the GN&C tests at the component, subsystem and spacecraft levels of assembly.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-CD&H-01	Spacecraft Telemetry and Command Handbook

3. Use:

The Spacecraft Telemetry and Command (T&C) Handbook provides a detailed and comprehensive description of all telemetry data and command packets needed for spacecraft, spacecraft controlled instrument, and payload operation.

4. Preparation Information:

Telemetry List
All telemetry, excluding those collected from the instruments, **shall** be identified using packet APIDs and appropriate labels if used.

Packet APIDs **shall** be grouped by spacecraft subsystem, instrument, and payload component.

The telemetry list **shall** contain the following as a minimum:

1) A detailed listing of all telemetry points including those needed for anomaly resolution and de-orbit operations

2) Key parameters and information necessary for the description and interpretation of all telemetry points, including spares

3) A description of each telemetry point and what it is measuring, engineering units, A to D resolution if appropriate, calibration data if appropriate, and green-yellow-red limits

4) Default, minimum, and maximum sample rates

Command List
All commands, excluding those forwarded to the instruments, **shall** be identified by packet APID and appropriate labels if used.

Packet APIDs **shall** be grouped according to subsystem, instrument, and payload component.

The command list **shall** contain the following as a minimum:

1) Detailed listing of all commands that can be applied to the spacecraft affecting configuration and operation in any way while in test or on orbit

2) Key parameters necessary for describing the command and its function

3) Description of command requirements information needed to understand the command's effect on the spacecraft and subsystems

Telemetry and Command Cross Reference
Listings of all commands and the telemetry points they effect. Two versions of this list are required. The first

is a listing by command APID and identifier and the second is a listing by telemetry APID and identifier.

Telemetry Packet Formats
The T&C Handbook **shall** provide detailed primary and secondary source packet header and data zone content definitions.

If CRCs are used, their computational algorithms **shall** be listed.

T&C Handbook Publication
Each release of the T&C Handbook **shall** be delivered electronically and via hard copy.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: SC-CD&H-02

2. Title: Satellite Telemetry and Command Handbook

3. Use:

The mechanism for moving telemetry and command packets between the spacecraft and ground is the CCSDS Advanced Orbiting System (AOS) Transfer Frame (TF). The Satellite Telemetry and Command Handbook (ST&C) describes AOS Transfer Frames used by GOES-R.

4. Preparation Information:

The ST&C Handbook **shall** contain detailed TF header format definitions for all downlink telemetry and uplink commands.

Telemetry Transfer Frame List

The ST&C **shall** list all telemetry TFs and include Master Channel ID (MCID), Virtual Channel ID (VCID), Virtual Channel Frame Count, Signaling Field, and Frame Error Control if used. The telemetry TF list **shall** include as a minimum mapping of source packet APID to downlink VCID, telemetry packet source, and packet description.

Command Transfer Frame List

The S&TC **shall** list all command TFs and include Transfer Frame Version Number, Bypass Flag, Control Command Flag, Spacecraft Identifier, VCID, Frame Length, and Frame Sequence Number. The command list **shall** contain as a minimum source packet APIDs by VCID and detailed TF data zone content descriptions.

ST&C Handbook Publication

Each release of the ST&C Handbook **shall** be delivered electronically and via hard copy.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:

SC-CD&H-03

2. Title:

Satellite Telemetry and Command Database

3. Use:

The Satellite Telemetry and Command (T&C) Database integrates all instrument and spacecraft T&C databases into a common T&C data management system. This database is needed for I&T and satellite operations.

4. Preparation Information:

The Satellite Telemetry and Command Database **shall** include all data items and parameters necessary to operate the instrument and spacecraft bus during ground test, launch and orbit raising, and all phases of on orbit operations.

The Satellite Telemetry and Command Database **shall** contain all data items, cross references, and other features listed in the spacecraft and instrument's T&C Handbooks.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-COMM-01	Detailed Block Diagrams of Communications Subsystem Units

3. Use:

The Detailed Block Diagrams of Communications Subsystem Units is used to understand the operation of the communication units and aid in failure analysis.

4. Preparation Information:

The Detailed Block Diagrams of Communications Subsystem Units **shall** show where all telemetry data (e.g. AGC, temperature, current, voltage) originate.

The Detailed Block Diagrams of Communications Subsystem Units **shall** be in sufficient detail to show all components and to be useful in assessing component failure analysis in system level testing and in operation.

The Detailed Block Diagrams of Communications Subsystem Units **shall** be updated whenever there is a hardware change.

In the Detailed Block Diagrams of Communications Subsystem Units, Digital units (if any) **shall** be illustrated by their analog equivalent where necessary. Thus an A to D converter can be represented by an A to D box and digital filter by an (analog) filter so that the logic of the digital units can be understood.

In the Detailed Block Diagrams of Communications Subsystem Units, all digital units **shall** have detailed descriptions explaining their operation.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-COMM-02	Communications Subsystem Level Test Data Package

3. Use:

To document and store the test data, and to flag non-conforming test results for the communications subsystem tests.

4. Preparation Information:

All test data provided to the Government by the vendor **shall** be in electronic form and be readable by the Government. This precludes the use of .pdf files for data.

The In the Communications Subsystem Level Test Data Package shall include the following:

1) "Strip chart" data **shall** be accumulated electronically
2) No paper strip charts **shall** be used.
3) Test data **shall** be electronically provided to the Government no later than 2 days after the data is taken.
4) A file structure for the test data **shall** be proposed by the vendor and agreed to by the Government. The purpose of the file structure is to ensure simplicity in locating data files.
5) Test data to be entered into the file structure **shall** include previously taken unit level tests and subcontractor data, for example, antenna gain profiles for assistance in understanding system level tests.
6) Data **shall** be entered by category and not primarily by the date on which it was taken.
7) Lifetime operating hours **shall** be recorded and reported along with the test data.
8) Test data **shall** be time and date stamped.
9) Test data **shall** be signed off by the cognizant vendor authority for the data.
10) Every test **shall** have a written test procedure, which **shall** be kept under configuration control with a formal procedure for making changes.
11) Revisions **shall** have a revision number and an appendix listing changes from previous revisions.
12) Test Procedures **shall** be provided to the Government 1 week before the test is carried out.
13) Test data **shall** be trended and trended data **shall** include specification limits.
14) The contractor **shall** evaluate the data taken during system testing for conformance with the applicable specification and programmatic requirements.

Effective Date: (Date of last signature)

As a minimum the Communications Subsystem Level Test Data Package **shall** contain:

1) Test data
2) Evidence of Quality Assurance acceptance data
3) Listing of test requirements verified
4) Summary description and commentary on the test data package
5) Test procedures as run
6) Test procedure change record listing
7) Data trending
8) Analysis used to demonstrate compliance with verification matrix requirements
9) Configuration identification list
10) Material review actions resulting from the tests
11) Test equipment calibration data
12) Test data **shall** be taken to at least a 95% confidence level
13) Failure report listing and copies as required, (including status/resolution if completed by submittal)
14) Operating time/cycle data

Due to the increased measurement speed the contractor **shall** consider the use of code word error rate as distinct from BER.

Error Vector Magnitude measurements may be used as a supplement to BER or CWER measurements.

Noise Power Ratio **shall** be measured using digitally synthesized noise.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: SC-COMM-03

2. Title: Communications Subsystem Performance Analysis Report

3. Use:

The Communications Subsystem Performance Analysis Report presents all analyses demonstrating that the Communications Subsystem meets GOES-R performance requirements.

4. Preparation Information:

The Communications Subsystem Performance Analysis Report **shall** consist of a series of technical memos, each written throughout the development of GOES-R.

The Communications Subsystem Performance Analysis Report **shall** describe and present in detail the predicted performance of the spacecraft communication subsystem and link margins.

The Communications Subsystem Performance Analysis Report **shall** contain, as a minimum, narrative, model data and analysis, where appropriate, addressing the following subjects as they pertain to the On-orbit Communications Subsystem functions.

In the Communications Subsystem Performance Analysis Report, link margins **shall** be calculated with the CCSDS RF Modulation Standard as a guide.

1) Link budgets and calculations with EOL link margins under worst-case conditions.

2) Analysis and modeling of the BER degradation due to digital transmission channel impairments such as filters, linearity effects (e.g., intermodulation noise, AM/PM conversion) and spurious signals.

3) Analysis of the frequency and channelization plan addressing self-interference, mutual interference, cross channel interference, filter and isolation requirements with the on-orbit antennas field of view predictions.

4) Transmission channel distortions and impairment analysis **shall** include: center frequency, signal path gain distribution, gain transfer curves, dynamic range, RF bandwidth, G/T, channel isolation, overload protection, AGC performance, phase linearity, gain flatness, carrier phase noise, AM/AM and AM/PM conversion, spurious PM, incidental AM, EIRP, axial ratio, C/N, spurious outputs, frequency stability, noise figure, time delay, active and passive intermodulation and BER.

5) The following technical performance parameters of the GOES-R Spacecraft communications subsystem hardware **shall** be presented in tabular form: component gain, loss, bandwidth, noise temperature, amplifier power, and EIRP. The gain/loss tabulation **shall** include as a minimum each connector, waveguide section, flange VSWR, diplexer loss, switch loss, SIT pads, amplifier gain and power, amplifier backoff, transmit and receive antenna gains, EIRP, pre-amp gain, VSWR effects and pre-amp and transponder noise temperature calculation. The document **shall** provide separately the tolerance of each channel or service parameter, and BOL/EOL margins **shall** be shown. The RF portion of the command and telemetry functions **shall** be included. The tabulated data **shall** also be delivered in Excel spreadsheet compatible files with the applicable formulas.

6) Analyses for all operating modes and configurations.

7) A reliability assessment of each subsystem component.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-COMM-04	Communications Subsystem Component Computer Simulation Models

3. Use:

The Communications Subsystem Component Computer Simulation Models provide predicted and measured (when available) data that represents the predicted and measured linear and nonlinear performance of each GOES-R communications subsystem component. NASA will use this data for transmission channel modeling to validate the spacecraft design and to evaluate the mission operations until EOL.

4. Preparation Information:

The Communications Subsystem Component Computer Simulation Models **shall** describe the predicted and measured performance of each Communication Subsystem component over temperature.

The Communications Subsystem Component Computer Simulation Models **shall** be delivered once and again to update each change in either the communications or T & C subsystem.

The Communications Subsystem Component Computer Simulation Models **shall** be at least raw tabulated printout data or preferably electronic standard format files representing the transfer function of the components time or frequency domain performance, including but not restricted to the following:

1) Analytical computer modeling or equivalent data for Design Verification:

    a. Receiver and transmitter gain transfer curves.

    b. Channelization and multiplexer filters data over frequency.

    c. Predicted on-orbit communications and T&C transfer orbit antenna patterns.

    d. Measured Data for Performance Verification of Engineering Model or First Article Flight Model will be provided for all communications RF electronic engineering model builds.

    e. Predicted on-orbit antenna coverage and polarization patterns **shall** be performed with no greater than 1 degree increment over twice the on-orbit coverage range with the spacecraft configured in the on-orbit configuration (deployables deployed).

    f. Composite coverage and polarization patterns for the T&C antenna system, made up of more than one discrete radiating element, **shall** be provided. Composite patterns may be derived analytically using an appropriate modeling tool. The amplitude and phase measurements of each discrete radiating element **shall** be used as model inputs. The modeling may use representative elements and scattering structures of the satellite in flight configuration

The Communications Subsystem Component Computer Simulation Models shall include the following:

2) All antenna patterns **shall** be performed at the assigned operating frequency or at lower edge and upper edge for antennas which provide for multiple carriers.

3) Each antenna pattern data **shall** be referenced to an isotropic antenna and the spacecraft axis.

4) All antenna pattern data **shall** be delivered in a standard electronic format.

5) The antenna pattern data **shall** include a tabulated antenna pattern printout.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: SC-COMM-05

2. Title: Communications Link Budgets

3. Use:

The Bit Error Rate (BER) degradation analyses (link budget) and modeling demonstrates that the GOES-R communications subsystem meets it's performance requirements.

4. Preparation Information:

The spreadsheets for the Communications Link Budgets **shall** be documented with explanations where necessary to describe the methodology used in the spreadsheet and any supporting technical analysis.

For the Communications Link Budgets See attached file: GOES-R Communications Link Budgets Worksheet

The Communications Link Budgets **shall** describe and present in detail the predicted performance of the spacecraft communication subsystem and link margins.

The Communications Link Budgets **shall** be on an Excel spreadsheet based on the attached spreadsheet.

The Communications Link Budgets spreadsheets **shall** be completed by adding the contractor's values to the empty cells and by adding additional cells to provide additional detail of the link impairments.

The Communications Link Budgets spreadsheet **shall** be a "live" spreadsheet, the cells **shall** be linked and the equations behind the values **shall** be in the spreadsheet rather than only the values themselves.

The Communications Link Budgets spreadsheet **shall** contain at a minimum, narrative, explanation of formula used and any model data and analysis, as appropriate and be updated as additional analysis and measured impairment data (e.g. spurs, crosstalk, antenna polarization isolation) becomes available.

The Communications Link Budgets link margins **shall** be calculated with the CCSDS RF Modulation Standard as a guide.

Communications Link Budgets technical memorandums analyzing the impact of impairments on the link **shall** also be included.

Communications Link Budgets **shall** be modified whenever new analysis or performance becomes available.

At a minimum, the Communications Link Budgets **shall** be updated and modified as given below.

1) Link budget with bidder's proposal. This **shall** be based on the attached link budget, expanded as necessary by the bidders to include all sources of link degradation.

2) Link Budget at PDR. This link budget **shall** update the previous link budget with the final unit specifications. It **shall** include all filter, switch, SIT attenuator, spur, waveguide/cable impairments. From the PDR on, the link budget **shall** show both the best case link (the highest link margin) and the worst case link (the lowest link margin)

3) Link Budget after unit testing. This will update the PDR link budget with measured unit performance.

4) Link budget for Spacecraft Thermal Vacuum Testing. This **shall** use the previous link budget to predict communication subsystem performance at spacecraft thermal vacuum testing. It **shall** predict performance through the primary and main redundant paths.

5) Link Budget for Post Launch Testing. The final link budget **shall** be modified to predict performance at the CDAS site used for Post-Launch Testing (PLT).

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: SC-COMM-06

2. Title: Communications Subsystem Reliability

3. Use:

The Communications Subsystem Reliability is used to evaluate the Communications Subsystem's ability to achieve GOES-R mission lifetime requirement. It will be used as input into the Probabilistic Risk Assessment and to evaluate the effects of design or configuration changes.

4. Preparation Information:

The Communications Subsystem Reliability consists of three parts, the Reliability Prediction (RP), the Failure Modes and Effects Analysis (FMEA), and the Fault Tree Analysis (FTA). These parts may be submitted together or in separate volumes.

The Communications Subsystem Reliability RP **shall** be prepared in accordance with the Mission Assurance Requirements.

1) Initial assessments **shall** use the parts count reliability prediction methodology of MIL-HDBK-217.
2) As design matures, develop a complete reliability block diagram, failure definitions, and mathematical models in accordance with MIL-HDBK-217.

The FMEA **shall** be prepared in accordance with the Mission Assurance Requirements.

The following **shall** be provided, as a minimum for the Communications Subsystem Reliability FMEA:

1) Failure modes analysis, including calculations of multipaction and corona margin for all components.
2) Severity levels of the failure effects as defined in the Mission Assurance Requirements.
3) Critical Items List (CIL)
4) Summary of Failure modes identified

The Communications Subsystem Reliability FTA **shall** be prepared in accordance with the Mission Assurance Requirements and the following provided as a minimum:

1) The ground rules for the analysis, including definitions of the undesirable end states analyzed,
2) References to documents and data used.
3) The fault tree diagrams.
4) Statement of the results and conclusions.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-COMM-07	Selection of Raw Data and GRB FEC Coding and Modulation

3. Use:

The Selection of Raw Data and GRB FEC Coding and Modulation documents the rationale behind the choice of coding and modulation for the GOES-R Raw and GRB links.

4. Preparation Information:

The Selection of Raw Data and GRB FEC Coding and Modulation **shall** include analysis, modeling results and supporting rationale for the contractor's choice of coding and modulation type for the GOES-R Raw and GRB links.

The Selection of Raw Data and GRB FEC Coding and Modulation report **shall** include link simulation results of the selected and competing coding and modulation types.

The Selection of Raw Data and GRB FEC Coding and Modulation **shall** provide narrative and explanation of the benefits and drawbacks of the selected and competing choices.

The Selection of Raw Data and GRB FEC Coding and Modulation narrative **shall** address all factors considered in the decision including the following.

1) Power efficiency

2) Bandwidth efficiency

3) Robustness of selected choice to expected interference environment

4) Cost and availability of space flight hardware and compatible ground systems

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-COMM-08	Communication Subsystem Unit Test Data Reports

3. Use:

To provide results of communications unit test in one report at the completion of unit testing.

4. Preparation Information:

The Communication Subsystem Unit Test Data Reports **shall** contain acceptance data from all communication units (LNAs, filters, receivers, HPAs, antennas), both those tested at the contractor's facilities and those tested at sub-contractors facilities.

The Communication Subsystem Unit Test Data Reports shall include the following:

1) If a unit is reworked, the regression test data **shall** also be included.
2) Data on switches and hybrids do not have to be included.
3) The results **shall** be arranged by type of unit, all units of one type **shall** be grouped together.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: SC-COMM-09

2. Title: Multipaction and Corona Test and Analysis Report

3. Use:

The Multipaction and Corona Test and Analysis Report document the tests and analysis that are performed on the spacecraft RF components to ensure adequate protection (with approved safety margins) has been provided for all potentially hazardous RF conditions.

4. Preparation Information:

The Multipaction and Corona Test and Analysis Report **shall** include multipaction and corona, plus any other RF condition that (in the contractor's opinion) may cause harm, or allow harm to be caused, to any component or subsystem on the spacecraft.

The Multipaction and Corona Test and Analysis Report **shall** include following information as a minimum:

1) An item by item list of all components that could be subject to hazardous RF conditions
2) Analysis of the worst case RF level, the associated safety factors that will be applied to each component, and the theoretical or practical basis used to derive such safety factors
3) Reports of all tests performed by the contractor or its suppliers to show each component will be able to withstand the predicted worst case RF levels

All issues of the Multipaction and Corona Test and Analysis Report **shall** be provided in a standard electronic format.

The initial draft copy of items 1) and 2) **shall** be provided as part of the PDR and subject to approval and discussion during the PDR.

A revised copy of items 1) and 2) **shall** be provided for approval as part of the CDR.

Item 3) with all measurement results **shall** be provided at least 60 days prior to the start of testing at the communications system level.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: SC-COMM-10

2. Title: Communications Subsystem Information Required for ITU and NTIA Filings

3. Use:

The Communication Subsystem Information Required for ITU and NTIA Filings deliverable provides the measured (or calculated, if measured data cannot be obtained) data required to support NOAA filing with ITU and NTIA for authorization to operate on the frequencies that will be used by the GOES-R series spacecraft.

4. Preparation Information:

The Communication Subsystem Information Required for ITU and NTIA Filings deliverable **shall** provide the following information for each signal, as a minimum:

1) For each transmission from the spacecraft:
    a. Power of the desired emission applied to the antenna connector
    b. Maximum spurious relative to the desired emission
    c. Harmonic levels: 2nd, 3rd, Other
    d. Emission bandwidth: 3 dB, 20 dB, 60 dB
2) For each signal received by the spacecraft:
    a. RF selectivity: 3 dB, 20 dB, 60 dB
    b. IF selectivity: 3 dB, 20 dB, 60 dB
    c. IF frequency
    d. Frequency of the first local oscillator
    e. Spurious rejection
    f. Image rejection
    g. Receive system noise temperature referenced to the antenna connector
3) For each antenna used on the spacecraft:
    a. Basic physical type
    b. Manufacturer's name and model number

c. Operating frequency range

d. Polarization type and orientation angle

e. Peak antenna gain referenced to the antenna connector

f. 1st sidelobe gain and angle from main lobe peak

g. Half Power Beam Width, parallel and at 90° to, the polarization orientation angle

4) For each antenna used on the spacecraft, the contractor **shall** also provide:

a. Radiation pattern measurements covering 4-Pi steradians with no greater than one degree increments for one axis and no more than 15 degree increments for the other axis

b. Co-polar and cross-polar radiation pattern measurements

c. Composite coverage and polarization patterns for any combination of two or more antennae that are used to simultaneously transmit or receive the same signal(s). The amplitude and phase measurements for each discrete radiating element, from items a) and b) above **shall** be used as inputs to the analytic model.

d. Predicted coverage contours of G/T and EIRP (in dB relative to the beam peak) for spacecraft located at longitudes 75°, 90°, 105°, and 137° west, using equi-rectangular (Plate-Carre)” projection and showing visible continents, countries.

e. All antenna measurements **shall** be performed at the assigned operating frequency or at the lower edge and upper edge for antennas that provide for multiple carriers. For any antenna operating over multiple, discontinuous, frequency bands, measurements **shall** be performed at the upper and lower edges of each operating band.

f. All antenna pattern data **shall** be referenced to an isotropic antenna and the spacecraft axes.

All data **shall** be provided in a standard electronic format.

If subsequent measurements on flight hardware show performance differences from the preliminary data, a revised report of the relevant subsection(s) **shall** be delivered not later than 60 calendar days after the measurements are made.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-COMM-11	Communications Subsystem Test Data Reports

3. Use:

The Communications Subsystem Test Data Reports provide detailed system test summary which will trend system level through system integration through final system performance.

4. Preparation Information:

The Communications Subsystem Test Data Reports shall ensure that each spacecraft **shall** have its own volume.

The Communications Subsystem Test Data Reports **shall** include, at a minimum, the following data:

1) Gain transfer curves
2) Power to antenna
3) BER (directly measured or indirectly such as from EVM) curves vs. ”uplink” power
4) Amplitude vs. frequency of each transponder (with and without AGC)
5) HPA Drain currents
6) Spurs
7) NPR for DCPR transponder
8) Absolute frequency, frequency translation and frequency stability

The Communications Subsystem Test Data Reports **shall** include the following Telemetry, Tracking, Command related information:

1) Command sensitivity
2) Minimum command amplitude lock/unlock power
3) Command frequency lock/unlock range
4) Ranging modulation index
5) Absolute time delay

Each measurement in the Communications Subsystem Test Data Reports **shall** be trended from the completion of the LNA/receiver, filter, HPA, output filter chain through ambient, thermal vacuum, final ambient, and RFA testing plus any other system level tests including any regression testing that is required.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-ELEC-01	Electromagnetic Interference (EMI) / Electromagnetic Compatibility (EMC) Plan

3. Use:

This document describes the design and test verification methods that will be used to ensure that the spacecraft will be compatible with the performance requirements.

4. Preparation Information:

The EMI/EMC Compatibility Plan **shall** include the following minimum material.

1) Description of how the spacecraft will be designed to ensure compatibility between the various subsystems, the launch vehicle, and all instruments.

2) Design and test plans that will be used at the system, spacecraft, bus, subsystem and component levels.

3) EMI/EMC test matrix that describes which components, and/or subsystems will be tested for Conducted Emissions, Conducted Susceptibility, Radiated Emissions, Radiated Susceptibility and Electrostatic Discharge.

4) Description of the EMI/EMC and ESD Test Plans.

5) Description of the proposed accept/reject test criteria that will be used at the system, spacecraft, bus, subsystem and component levels of assembly.

6) Description of proposed design guidelines that will be employed to ensure that the EMI/EMC requirements will be met, such as bonding, grounding and isolation, wiring harnesses design, EED circuits, and shielding.

7) Describe the plan for providing the predicted and measured values of the S/C radiated emission levels at the GFP instrument locations, especially the emissions into the GFP instrument apertures.

The scope of the EMI/EMC Compatibility Plan **shall** include the spacecraft, instruments, and associated ground support equipment.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: **2. Title:**

SC-ELEC-02 **Spacecraft Power Energy Balance Model and Analysis Report**

3. Use:

For the use of NASA in the prediction power loads levels and profiles during the mission.

4. Preparation Information:

System level energy balance model and analysis of the power system steady-state performance as a function of load profiles and solar array illumination, (or alternate power source) for launch, on-orbit, and test configurations

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-ELEC-03	Power Subsystem Analysis Report

3. Use:

To document the power subsystem analyses to assure the power subsystem design is meeting or exceeding the power requirements for all modes of operation. To sanity check the power subsystem analyses. To document performance characterization of power electronics unit.

4. Preparation Information:

The Power Subsystem Analysis Report **shall** include the following:

1) Power subsystem requirements & allocation.
2) Power budget for all operating modes.
3) Power subsystem verification matrix.
4) Power subsystem failure modes and effects
5) Power subsystem reliability.
6) Launch & orbit raising (LOR) power
7) Safe hold power
8) Power electronics design & performance
9) Power distribution design
10) Summary of battery design.
11) .Battery depth -0f - discharge (DOD) for all operating modes.
12) Solar array design parameters summary.
13) Launch & orbit raising (LOR) power
14) Solar array deployment power.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: **2. Title:**

SC-ELEC-04 **Power Profile Report**

3. Use:

To establish the detailed and current performance requirements and capabilities for the power subsystem in all modes and phases of operation.

To provide input data for the thermal mathematical models and for mission operations plans and procedures.

4. Preparation Information:

The Power Profile Report shall include all significant power loads for all significant phases of the mission from pre-launch (turn-on) operation through launch, transfer orbit, on-orbit storage, and orbital operation, including both sunlight orbit and eclipse orbit modes and phases.

Delivery of the Power Profile Report may be accomplished by posting the latest version of the power profile report to EDDS.

The power consuming elements of the Power Profile Report shall be broken down into, at least, the following:

1) **The elements that are individually controlled by command or automatic program.**
2) **Individual boxes or stacks, where a stack of boxes operates in combination as a single power consuming unit.**
3) **Converter and transmission losses.**

Power consumption in the Power Profile Report shall be broken down into, at least, the following categories:

1) **Maximum operating, minimum operating and orbital average power values, including specific descriptions regarding duty cycles shall be provided.**
2) **In-rush current peaks and peak transient current events shall be identified.**

In the Power Profile Report, the source and basis for the estimate (e.g., design estimate, bread board estimate, exact previous hardware measurement, etc.) of the data used to define the dissipation of each load shall be explicitly identified.

Solar array current and battery performance and margins in the Power Profile Report shall be provided along with source and descriptors for the data.

The Power Profile Report shall describe the power requirements for each satellite mode of operation that is described in the S-415-22 Performance Specification.

Detailed power profiles in the Power Profile Report shall be presented, to the maximum extent possible, in both tabular and graphical form.

Effective Date: (Date of last signature)

The Power Profile Report shall be updated for each spacecraft as parameters change.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-ELEC-05	Solar Panel & Solar Array Assembly Output Power Predictions

3. Use:

To document GOES R series solar panel and solar array assembly output power predictions and I-V characterization for future on-orbit verification and validation. To evaluate and sanity check GOES R series solar array radiation fluence degradation due to trapped protons, trapped electrons, and solar flare protons.

4. Preparation Information:

To be updated.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
SC-ELEC-06	Battery Design and Performance Analysis

3. Use:

To document Battery Design and Performance Analysis to support on-orbit verification and validation and any future on-orbit anomaly investigations related to the GOES R series battery. To evaluate and sanity check battery capacity and battery capacity degradation analysis & rationales. To evaluate and sanity check battery depth-of-discharge (DOD) analysis to support on-orbit verification and validation. To document the GOES R series battery and cell charge/discharge voltage profile over mission life to support on-orbit verification and validation and any future on-orbit anomaly investigation. To evaluate and sanity check the GOES R series battery thermal analysis to support on-orbit verification and validation and any future on-orbit anomaly investigation.

4. Preparation Information:

The spacecraft contractor **shall** provide the Battery Design and Performance Analysis to support on-orbit verification and validation and any future on-orbit anomaly investigation related to the GOES R series battery.

The spacecraft contractor **shall** include the following in the Battery Design and Performance Analyses:

1) Battery nameplate capacity (C) analysis from beginning-of-life (BOL) to end-of-life (EOL), to include:

    a. Process to maintain battery nameplate capacity (C) from BOL to EOL.

    b. Cell manufacturer process to establish a cell rated capacity (C) from measured cell capacity data at a specific temperature, discharge rate, and discharge voltage so that the rated cell capacity (C) and the battery nameplate capacity (C) is achieved from BOL to EOL.

    c. Cell manufacturer margin between the measured cell capacity and the cell rated capacity.

    d. Measured battery capacity and its degradation over mission life. Battery capacity degradation due to the mission charge/discharge cycles, calendar life aging, and any other factor contributing to capacity degradation.

    e. Battery capacity degradation rationales from life test data on the GOES R battery or similar battery with similar cells.

    f. Predicted battery capacity vs. nameplate capacity and justification rationale at the autumnal equinoxes at the following intervals over mission life:

        i. Launch

        ii. 2 years on-orbit storage

        iii. Beginning-of-life (BOL, 5 years on-orbit storage)

        iv. 10 years after launch (includes 5 years on-orbit storage and 5 years on-orbit operation)

v. End-of-life (EOL, includes 5 years on-orbit storage and 10 years on-orbit operation)

2) Battery depth-of-discharge (DOD) analyses for all mission modes, to include:

a. Battery DOD at launch, orbit-raising, on-orbit solstices (winter & summer), and on-orbit equinoxes.

b. Performance of the battery nameplate capacity (C) with and without 1 cell failure for eclipses up to 72 minutes at the autumnal and vernal equinoxes.

c. Battery DODs for any peak power operations or failure modes. Lunar eclipses following an equinox seasonal eclipse or any maneuvers requiring additional power from the battery. Failure to acquire the sun after a 72-minute eclipse and a worst-case sun acquisition to reacquire the sun.

d. Rationale to support the calculated battery DODs including total spacecraft load during battery discharge, cell failures, average cell voltage during discharge, and battery temperature.

3) Cell and Battery voltage charge/discharge profile over mission life, to include:

a. Prediction of voltage charge/discharge profiles during the equinoxes at the following intervals over mission life:

i. Launch

ii. 2 years on-orbit storage

iii. Beginning-of-life (BOL, 5 years on-orbit storage)

iv. 10 years after launch (includes 5 years on-orbit storage and 5 years on-orbit operation)

v. End-of-life (EOL, includes 5 years on-orbit storage and 10 years on-orbit operation)

b. Any on-orbit data or test data which provides rationale to support the predicted voltage charge/discharge profiles.

c. Description of charging schemes and the charge rates utilized during eclipse seasons and solstice seasons over mission life. Rationale that includes on-orbit or life-cycle test data and supports these particular charging schemes and charge rates.

d. Description of the charge efficiencies and their degradation for the predicted GOES R on-orbit charge/discharge cycle during equinox season eclipses over mission life. Rationale from on-orbit data or measured data that supports the charge efficiency profiles over mission life.

e. Description & justification of the c/d ratio for the proposed on-orbit charge/discharge profiles during equinox season eclipses over mission life. On-orbit data or measured test data.

f. Predictions of cell voltage charge/discharge profile for any lunar eclipses following an equinox seasonal eclipse or any peak power operations requiring battery power.

g. Predictions of the battery charge/discharge voltage profile for any peak power operations requiring battery power. Load and the duration of discharge and the charge rate during recharge.

Justification for charge rate and c/d ratio utilized for recharge with on-orbit data or test data.

4) Battery thermal analysis that addresses all mission modes from launch to EOL, to include:

   a. Description of the battery thermal design approach, to include: heat flow diagrams, cell dissipations, heater sizing, radiator sizing, thermal modeling approach, and discussion of heritage aspects of battery thermal design.

   b. Prediction of battery temperatures for launch, orbit-raising, initial outgas, on-orbit storage, and on-orbit operation (BOL & EOL) at the summer solstice, winter solstice, autumnal equinox, and vernal equinox. Include the predictions at the following mission milestones:

      i. Launch

      ii. 2 years on-orbit storage

      iii. Beginning-of-life (BOL) after 5 years on-orbit storage

      iv. 10 years on-orbit (5 years on-orbit storage and 5 years on-orbit operation)

      v. End-of-life (EOL) 15 years on-orbit (5 years on-orbit storage and 10 years on-orbit operation).

   c. Prediction of cell-to-cell temperature gradients within the battery-to-battery temperature gradients if there are multiple batteries. Justification for these predictions through analysis, test, or on-orbit data.

5) Battery dimensions and mass analysis, to include:

   a. Battery dimensions and mass.

   b. Dimensions of the battery cells and mass of cells.

   c. Mass of the battery chassis.

   d. Mass of the bypass diodes and battery temperature sensors.

   e. Specific energy of the battery.

6) Battery failure mode & effects analysis, to include:

   a. Demonstration of the single fault tolerant design of the battery.

   b. Failures within the battery and their effects.

   c. Cells failing short or open and their effects.

   d. Overcharging of the battery cells.

   e. Overheating of the battery cells and battery.

   f. Cell voltage monitoring failures and their effects.

   g. Battery temperature or cell temperature sensor failures and their effects.

   h. By-pass diode failures and its effects.

7) Battery reliability analysis for 5 years of ground storage, 5 years of on-orbit storage, and 10 years of on-orbit operation.

8) Battery structural analysis, to include:

   a. Battery chassis structural margins vs. launch loads

   b. Unit level vibration test levels and how they envelope the expected launch environment

   c. Fatigue analysis, inlcuding the number of times the battery can be removed from the spacecraft without replacement of hardware.

   d. Flatness requirements and criticality to thermal control

9) Battery heritage analysis, to include:

   a. Heritage geosynchronous orbit programs for GOES R series flight battery

   b. Number of successful on-orbit years each heritage geosynchronous orbit GOES R series battery has

   c. Number of cell failures each heritage geosynchronous orbit GOES R series battery has

   d. Heritage components of the GOES R series battery design and what programs are flying these aspects of the GOES R series battery design

   e. Number of successful on-orbit years each heritage component of the GOES R series battery design has

   f. Number of failures each heritage component of the GOES R series battery design has

10) Summary of the battery design and cell design details with the following information:

   a. Battery cell manufacturer

   b. Battery cell type

   c. Battery cell rated capacity/nameplate capacity at specific charge rate, discharge rate, temperature, and end-of-discharge voltage

   d. Expected measured battery cell capacity at specific charge rate, discharge rate, temperature, and end-of-discharge voltage

   e. Number of battery cells in series

   f. Number of battery cells in parallel

   g. Battery manufacturer

h. Battery nameplate capacity at specific charge rate, discharge rate, temperature, and end-of-discharge voltage

i. Battery cell by-pass circuitry

j. Battery cell voltage monitoring

k. Battery and cell temperature monitoring

l. Battery cell overcharge protection

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: SC-ELEC-07

2. Title: Battery Cell Acceptance Test Plan

3. Use:

To document the Battery Cell Acceptance Test Plan to assure sufficient test verification for the GOES R series flight cells.

This CDRL provides the Battery Cell Acceptance Test Plan. It defines the test plan objectives, requirements verification, test equipment & test facility for performing the tests, tests and sequence of testing which will be performed, and the plan for data storage and archiving of the test data.

4. Preparation Information:

The Battery Cell Acceptance Test Plan **shall**:

1) Define the objectives of the Battery Cell Acceptance Test Plan.

2) Define the battery cell requirements that will be verified through the implementation of the Battery Cell Acceptance Test Plan.

3) Define the facility and test equipment that will be utilized to perform the battery cell acceptance testing.

4) Identify the following tests that should be performed in the following sequence for the battery cell acceptance testing:

    a. Cell mass measurement

    b. Electrolyte leakage rate

    c. Insulation resistance

    d. 20 °C capacity test

    e. 20 °C charge retention test (72 hr open circuit)

    f. 10 °C capacity test

    g. 30 °C capacity test

    h. Insulation resistance

    i. Electrolyte leakage

    j. Final visual inspection

5) Define the plan for recording and archiving the battery cell acceptance test data.

Effective Date: (Date of last signature)

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-ELEC-08	Battery Cell Qualification Test Plan

3. Use:

To document the battery cell qualification test plan to assure sufficient qualification and test verification of the GOES R series flight cells.

It defines the test plan objectives, requirements verification, test equipment & test facility for performing the tests, tests and sequence of testing which will be performed, and the plan for data storage and archiving of the test data.

4. Preparation Information:

The Battery Cell Qualification Test Plan **shall**:

1) Define the objectives of the Battery Cell Qualification Test Plan.
2) Define the battery cell requirements that will be verified through the implementation of Battery Cell Qualification Test Plan.
3) Define the facility and test equipment that will be utilized to perform the battery cell qualification testing.
4) Identify the following tests that should be performed in the following sequence for battery cell qualification testing:
    a. Cell mass measurement
    b. Electrolyte leakage rate
    c. Insulation resistance
    d. 20 °C capacity test
    e. 20 °C charge retention test (72 hr open circuit)
    f. 0 °C capacity test
    g. 10 °C capacity test
    h. 30 °C capacity test
    i. 40 °C capacity test
    j. Insulation resistance
    k. Electrolyte leakage

l. Final visual inspection

5) Define the plan for recording and archiving the battery cell qualification test data.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: SC-ELEC-09

2. Title: Battery Acceptance Test Plan

3. Use:

To document the battery acceptance test plan to assure sufficient qualification and test verification of the GOES-R series battery.

The Battery Acceptance Test Plan defines the test plan objectives, requirements verification, test equipment & test facility for performing the tests, tests and sequence of testing which will be performed, and the plan for data storage and archiving of the test data.

4. Preparation Information:

The Battery Acceptance Test Plan **shall**:

1) Define the objectives of the GOES R series flight battery acceptance test plan.
2) Define the battery requirements that will be verified through the implementation of the Battery Acceptance Test Plan.
3) Define the facility and test equipment that will be utilized to perform the battery acceptance testing.
4) Identify the following tests which should be performed in the following sequence for the battery acceptance testing:
    a. Functional testing
        i. Electrolyte leakage rate
        ii. Insulation resistance
        iii. Temperature sensor check-out
        iv. 20 °C capacity test
        v. 20 °C charge retention test (72 hr open circuit)
        vi. Discharge pulse test
    b. Environmental testing with battery charged
        i. Random vibration (battery charged)
        ii. 20 °C capacity test
        iii. Thermal-vacuum testing

1. Minimum of 12 cycles, maximum of 15 cycles
2. Hot/cold plateau test in vacuum with a minimum of 4 electrical charge/discharge cycles and 3 consecutive stable cycles

c. Battery capacity testing

i. 20 °C capacity test

ii. 10 °C capacity test

iii. 30 °C capacity test

d. Repeat functional testing

i. Insulation resistance

ii. Electrolyte leakage

iii. Temperature sensor check-out

iv. 20 °C charge retention test (72 hr open circuit)

v. 20 °C capacity test

vi. Discharge pulse test

e. Physical measurements (e.g. mass, dimensions, volume)

f. Final visual inspection

5) Define the plan for recording and archiving the battery acceptance test data.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: SC-ELEC-10

2. Title: Battery Qualification Test Plan

3. Use:

To document the Battery Qualification Test Plan to assure sufficient qualification and test verification of the GOES R series battery.

The Battery Qualification Test Plan defines the test plan objectives, requirements verification, test equipment & test facility for performing the tests, tests and sequence of testing which will be performed, and the plan for data storage and archiving of the test data.

4. Preparation Information:

The Battery Qualification Test Plan **shall**:

1) Define the objectives of the Battery Qualification Test Plan.
2) Define the battery requirements that will be verified through the implementation of the Battery Qualification Test Plan.
3) Define the facility and test equipment that will be utilized to perform the battery qualification testing.
4) Identify the following tests that should be performed in the following sequence for the battery qualification testing:
    a. Functional testing
        i. Electrolyte leakage rate
        ii. Insulation resistance
        iii. Temperature sensor check-out
        iv. 20 °C capacity test
        v. 20 °C charge retention test (72 hr open circuit)
        vi. Discharge pulse test
    b. Environmental testing with battery charged
        i. Random vibration (battery charged)
        ii. Sine vibration (battery charged)
        iii. Sine burst test (battery charged)

- iv. 20 °C capacity test
- v. Discharge pulse test
- vi. Thermal-vacuum testing
  1. Minimum of 12 cycles, maximum of 15 cycles
  2. Hot/cold plateau test in vacuum with a minimum of 4 electrical charge/discharge cycles and 3 consecutive stable cycles

c. Battery capacity testing
- i. 20 °C capacity test
- ii. 0 °C capacity test
- iii. 10 °C capacity test
- iv. 30 °C capacity test
- v. 40 °C capacity test

d. Repeat functional testing
- i. Insulation resistance
- ii. Electrolyte leakage
- iii. Temperature sensor check-out
- iv. 20 °C charge retention test (72 hr open circuit)
- v. 20 °C capacity test
- vi. Discharge pulse test

e. Physical measurements (e.g. mass, dimensions, volume)

f. Final visual inspection

5) Define the plan for recording and archiving the battery qualification test data.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
SC-ELEC-11	Battery Life Test Plan

3. <u>Use:</u>

To document the Battery Life Test Plan to assure the GOES-R series battery can meet or exceed the GOES-R mission life requirements.

The Battery Life Test Plan defines the test plan objectives, requirements verification, test equipment & test facility for performing the tests, tests and sequence of testing which will be performed, and the plan for data storage and archiving of the test data.

4. <u>Preparation Information:</u>

The Battery Life Test Plan **shall**:

1) Define the objectives of the Battery Life Test Plan.
2) Define the battery requirements that will be verified through the implementation of the Battery Life Test Plan.
3) Define the facility and test equipment that will be utilized to perform the battery life testing.
4) Identify the following flow and tests that should be performed in the following sequence for the battery life testing:
    a. GOES R life test battery cell manufacturing & test
        i. **Shall** be built to GOES R flight cell manufacturing processes and procedures.
        ii. **Shall** be acceptance tested per GSFC approved Battery Cell Acceptance Test Plan.
    b. GOES R life test battery assembly & test
        i. **Shall** be built to GOES R flight battery manufacturing processes and procedures.
        ii. **Shall** be acceptance tested per GSFC approved Battery Acceptance Test Plan.
    c. GOES R life testing
        i. Mission life charge/discharge cycles
            1. **Shall** complete greater than or equal to the number of mission charge/discharge cycles x 1.2.
            2. **Shall** complete mission life charge/discharge cycles at 80% depth-of-discharge (DOD) of the nameplate capacity. Note, the required minimum capacity at 20 °C at a C/2 discharge is 1.2 x the battery nameplate capacity.

3. Cycles **shall** be at the worst-case average temperature during the discharge/charge cycles during eclipse season.

ii. GOES R flight battery acceptance testing

1. GOES R flight battery acceptance testing per the GSFC approved Battery Acceptance Test Plan after the completion of the life test mission life charge/discharge cycles.

iii. Accelerated geosynchronous-earth-orbit (GEO) life testing

1. **Shall** complete ≥ 30 earth eclipse seasons (approximately 45 days each)
2. **Shall** complete ≥ 30 accelerated solstice seasons (approximately 14 days each)
3. **Shall** consist of on-orbit real-time eclipse season discharge/charge profile with a maximum DOD of 75% of the nameplate capacity on the longest eclipse days.
4. **Shall** consist of on-orbit solstice season charge and battery SOC profiles with the on-orbit duration being shortened to approximately 14 days.
5. Battery **shall** be maintained at the average expected temperatures during the discharge/charge cycles during the autumnal equinox and vernal equinoxes.
6. Battery **shall** be maintained at the average expected temperatures during the summer solstice and winter solstice seasons.
7. Cell voltage balancing **shall** be tested as it will be used on-orbit.

iv. GOES R flight battery acceptance testing

1. **Shall** complete GOES R flight battery acceptance testing per the GSFC approved Battery Acceptance Test Plan after the completion of the accelerated GEO life testing.

5) Define the plan for recording and archiving the Battery Life Test Data.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
SC-ELEC-12	Battery Handling, Storage, and Transportation Plan

3. <u>Use:</u>

The Battery Handling, Storage, and Transportation Plan provides the necessary plans and procedures for the GOES-R series battery handling, storage, packaging, transportation, installation, testing, maintenance, operation, and safety to ensure the GOES-R series battery remains compliant with its requirements.

4. <u>Preparation Information:</u>

The Battery Handling, Storage, and Transportation Plan shall include storage temperature, operating temperature, packaging, storage, state-of-charge, and other battery health and safety considerations.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u> **2. <u>Title:</u>**

SC-ELEC-13 Solar Panel Qualification Test Plan

3. <u>Use:</u>

To document the solar panel qualification test plan to assure the solar panel(s) can meet or exceed the solar panel requirements.

4. <u>Preparation Information:</u>

To be updated.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
SC-ELEC-14	Solar Panel and Solar Array Acceptance Test Plan

3. <u>Use:</u>

To document the Solar Panel and Solar Array Acceptance Test Plan to assure the flight solar panel(s) and flight solar array can meet or exceed the solar panel and solar array requirements.

4. <u>Preparation Information:</u>

To be updated.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
SC-PROP-01	Propulsion Subsystem Performance Analysis Report

3. <u>Use:</u>

To document and verify that the propulsion subsystem design will satisfy the required performance criteria and will meet overall mission objectives.

4. <u>Preparation Information:</u>

The propulsion subsystem performance analysis report **shall** include, but not be limited to, the following analyses:

1) Propulsion performance for the following orbit control functions:

    a. Geosynchronous orbit insertion

    b. East/West and North/South stationkeeping maneuvers

    c. Required on-orbit repositioning maneuvers

    d. Injection into end-of-life orbit

    For each function address the following:

    i. Maximum and minimum firing duration

    ii. Maximum and minimum thrust level

    iii. Thrust vector misalignment tolerance

    iv. Number of engine starts

    v. Total impulse required for orbit control

    vi. Thruster duty cycles

2) Propulsion performance for attitude control including the following:

    a. Maximum and minimum firing duration

    b. Maximum and minimum thrust levels

    c. Thrust vector misalignment tolerance and CG shift on limit cycling

    d. Total impulse required for attitude control

    e. Thruster duty cycles

3) Propulsion performance for any failure mode in the propulsion subsystem or other bus failure which has an impact on propellant consumption or thruster usage. The failure modes should address the

following:

a. Ascent phase

b. On-orbit phase

c. Acquisition mode

d. Momentum unloading

e. East/West and North/South stationkeeping

For each function address the following:

i. Operational scenario

ii. Operational constraints

iii. Propellant penalty for each scenario

4) Detailed propellant budget for each mission function including all system inefficiencies, system pressure drop, and thrust decay over mission life.

5) The propulsion subsystem report **shall** also include, but not be limited to, the following analyses:

a. Stress/loads

b. Power

c. Thermal

d. Contamination/plume impingement

e. Slosh

f. Pressure surge

g. Telemetry and command interfaces

6) Subsystem operation scenario and time line to include system utilization during launch to orbit phase.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-FLSW-01	Software Management Plan

3. Use:

To define the contractor's systematic approach to, and processes used in, the management, development, testing (verification, validation, and qualification), documentation, configuration management, and quality assurance of the Spacecraft Flight Software.

4. Preparation Information:

The Software Management Plan **shall** apply to all software developed by the contractor for the GOES-R Program, including any software used to conduct system testing.

The Software Management Plan **shall** include:

1) A description of practices, tasks, and activities performed as a basis for contractor effort and schedule determination.

2) A table indicating the criticality classification and justification for each CSCI, in accordance with the definitions for Class A, B, C, D, E, F, G and H software in Appendix B of NPR 7150.2.

3) A table mapping applicable software processes and/or SMP sections to show compliance with the following NPR 7150.2 sections: 2.2, 2.3, 2.4, 3 (all), 4.1, 4.2, 4.3, 4.4.1, 4.4.2, 4.4.3, and 5. Include a justification for any areas where a gap exists.

4) A table containing a mapping of applicable SW Lifecycle Process activities/reviews/milestones to at least the CSCI level.

5) The plans for acquiring software which will be an integral part of the spacecraft flight software. Include a description of all subcontractor management and monitoring.

6) The definition of the software decomposition criteria.

7) A description of the software development management organization, including the organization chart, and a description of how the software personnel structure is integrated into the overall spacecraft development organization. Include a functional description of the duties of the positions defined on the organization chart, and their relationship to the accomplishment of WBS tasks.

8) A discussion of the peer review/inspection process of software work products. Include a discussion of how both the informal and formal software reviews fit into the software development lifecycle, the spacecraft design reviews, and spacecraft development lifecycle. Indicate NASA, DCMA, and contractor SQA participation in reviews where applicable.

9) An identification of any deviations from the standard life cycle necessary to accommodate the integration of commercially acquired software. Specifically include justification for less than thorough testing of COTS software.

10) An identification of any modifications to the standard software development lifecycle to accommodate the integration of existing or planned reuse software.

11) A description of all selected software languages(s) along with the selection justification.

12) A description of software protection against vandalism, viruses, unauthorized access, and disaster risks.

13) The software lifecycle model, including a description of software integration and hardware/software integration processes, software delivery, and maintenance. Include a description of the methodologies used in performing software requirements analysis and interface control, and software design and implementation. Describe the techniques used to transition between the two methodologies.

14) A Risk Management section describing the processes and methods by which technical, cost, and schedule risks will be identified, evaluated, and minimized.

15) A Software Configuration Management Plan section describing the configuration management process for the software and its associated products. Clearly define the relationship between the software configuration management approach and that employed by the remainder of the project. The Software Configuration Management (SCM) Plan should include:

    a. SCM Management Overview -Organization, responsibilities, and interfaces and relationships to software life cycle;

    b. Software Configuration Management Activities:

        i. Configuration Identification

        ii. Configuration Control

        iii. Status Accounting

        iv. Configuration Audits and Reviews;

    c. Schedule information, which establishes the sequence and coordination for the identified activities and for all events affecting the Plan's implementation.

    d. Software Configuration Management Resources -tools, techniques, equipment, personnel, and training.

    e. Software Release management and delivery.

    f. Maintenance information, which identifies the activities and responsibilities necessary to ensure continued planning during the life cycle of the project.

16) An identification of the constraints to which the development process is subject (e.g. methodologies, resource limitation, hardware processors, external dependencies, reuse of existing software).

17) A description of software build definition, build planning rationale, and methodology used.

18) Provide an overall view of the software test program, detailing test philosophy objectives and rationale

for all software testing and hardware/software integration activities planned for the program. Include a discussion of the approach for providing independent testing above the lowest code level (unit or CSU).

19) A description of the software development system and software test bed facility required to develop, test, evaluate and demonstrate that the software is in compliance with specifications. Describe any software development effort necessary for the integration, operation or use of these systems.

20) A discussion of software metrics collected and their use.

21) A Software Reliability Plan which documents the activities to be undertaken to achieve the software reliability requirements, as well as describe the activities to be undertaken to demonstrate that the software reliability requirements have been verified.

22) A description of the software safety program approach, which documents the activities to be undertaken to achieve the software safety requirements, as well as describe the activities to be undertaken to demonstrate that the software safety requirements have been verified.

23) A Software Maintenance Plan which provides insight into the method, approach, responsibility, and processes to be followed for maintenance of software and its associated documentation. Describe the specific standards, methods, tools, actions, procedures, and responsibilities associated with the software maintenance process. Include the approach for the scheduling, implementation, and tracking of software upgrades.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
SC-FLSW-02	Software Assurance Plan

3. <u>Use:</u>

Details the procedures, reviews, and audits required to accomplish software assurance.

4. <u>Preparation Information:</u>

The Software Assurance Plans **shall** be written per NASA-STD-8739.8, NASA Software Assurance Standard.

Contractor format is acceptable

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-FLSW-03	Software Requirements Specification

3. Use:

The Software Requirements Specification details the software performance, interface, operational, and quality assurance requirements for each CSCI allocated down to the unit (or CSU) level.

4. Preparation Information:

A Software Requirements Specification **shall** be delivered for all Class B software.

The Software Requirements specification **shall** be delivered in a format that includes DOORS compatible linked interrelationships with all higher and lower level specifications.

The Software Requirements Specification **shall** contain:

1) System overview
2) CSCI requirements (allocated/derived to the unit level)
    a. Functional requirements
    b. Required states and modes
    c. External interface requirements
    d. Internal interface requirements
    e. Internal data requirements
    f. Adaptation requirements
    g. Safety requirements
    h. Performance and timing requirements
    i. Security and privacy requirements
    j. Environment requirements
    k. Computer resource requirements.
        i. Computer hardware resource utilization requirements
        ii. Computer software requirements
        iii. Computer communications requirements

l. Software quality characteristics

m. Design and implementation constraints

n. Personnel-related requirements

o. Training-related requirements

p. Logistics-related requirements

q. Packaging requirements

r. Precedence and criticality of requirements

3) Verification/Qualification provisions

4) Requirements traceability and verification data allocated down to the unit (CSU) level

5) Requirements partitioning for phased delivery

6) Testing requirements that drive software design decisions; e.g., special system level timing requirements/checkpoint restart.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-FLSW-04	Software Design Document

3. Use:

Thoroughly describes CSCI-wide design decisions, the CSCI architectural design, and the detailed design needed to implement the software.

4. Preparation Information:

A Software Design Document **shall** be delivered for all Class B software.

Contractor Format is Acceptable

The Software Design Document **shall** include:

1) CSCI-wide design decisions/trade decisions.
2) CSCI architectural design.
3) CSCI decomposition and interrelationship between components.
    a. CSCI components:
        i. Description of how the software item satisfies the software requirements, including algorithms, data structures, and functional decomposition.
        ii. Software item input/output description.
        iii. Static/architectural relationship of the software units.
        iv. Concept of execution including data flow, control flow, and timing.
        v. Requirements traceability.
        vi. CSCI's planned utilization of computer hardware resources.
    b. Rationale for software item design decisions/trade decisions including assumptions, limitations, safety and reliability related items/concerns or constraints in design documentation.
    c. Interface design.
4) CSCI Implementation Plan.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-FLSW-05	Software Test Plan

3. Use:

Thoroughly describes the plans for software unit/component level testing, software integration testing, and software qualification testing. The plan describes the software test environment to be used for testing, identifies the tests to be performed, and provides schedules for environment, development, and test activities. The plan provides an overview of software testing, test schedules, and test management procedures.

4. Preparation Information:

A Software Test Plan **shall** be delivered for all Class B software.

Contractor format acceptable.

The Software Test Plan **shall** include:

1) Test levels.
2) Test types (e.g., unit testing, software integration testing, end-to-end testing, Software Requirements Specification verification/acceptance/qualification testing, regression testing).
3) Test classes.
4) General test conditions.
5) Test progression.
6) Data recording, reduction, and analysis.
7) Test coverage (breadth and depth) or other methods for ensuring sufficiency of testing.
8) Planned tests, including items and their identifiers.
9) Test milestones.
10) Software Requirements Verification (traceability) Matrix.
11) Software Requirements Specification verification/qualification testing environment, site, personnel, and participating organizations.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: SC-FLSW-06

2. Title: Software Test Procedures

3. Use:

Describes the test preparations, test cases, and test procedures to be used to perform verification testing of a CSCI against the Software Requirements Specification. This document defines the detailed test procedures and test cases that will be used in executing software tests to demonstrate that all software requirements have been met

4. Preparation Information:

Software Test Procedures **shall** be delivered for all Class B software.

Contractor format acceptable.

The Initial Version of the Software Test Procedures **shall** include preliminary descriptions for all tests to be used in formal verification testing, without the detailed instructions (steps).

The Final Version of the Software Test Procedures **shall** include complete test descriptions for all tests to be used in formal verification testing.

The Software Test Procedures **shall** contain:

1) Test preparations, including hardware and software
2) Definition of each test case
3) Test descriptions, including:
    a. Test identifier
    b. System or CSCI requirements addressed by the test case.
    c. Prerequisite conditions
    d. Test input
    e. Detailed instructions (steps) for conducting procedure
    f. Expected test results, including criteria for evaluating results, and assumptions and constraints
    g. Criteria for evaluating results
4) Requirements traceability
5) Identification of test configuration

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-FLSW-07	Software Test Report

3. Use:

A record of the verification testing performed on a CSCI against the Software Requirements Specification.

4. Preparation Information:

A Software Test Report **shall** be delivered for all Class B software.

Contractor format acceptable.

The Preliminary Version of the Software Test Report **shall** address the results of CSCI Integration Testing and Formal Test Dry-Run.

The Final Version of the Software Test Report **shall** address the results of CSCI Formal Verification/Qualification Testing.

The Software Test Report **shall** include:

1) Overview of the test results.

    a. Overall assessment of the software as demonstrated by the test results.

    b. Remaining deficiencies, limitations, or constraints detected by testing. (e.g., including description of the impact on software and system performance, the impact a correction would have on software and system design, and recommendations for correcting the deficiency, limitation, or constraint).

    c. Impact of test environment.

2) Detailed test results.

    a. Project-unique identifier of a test and test procedure(s).

    b. Summary of test results (e.g., including requirements verified).

    c. Problems encountered.

    d. Deviations from test cases/procedures.

3) Test log (Final Version Only).

    a. Date(s), time(s), and location(s) of tests performed.

    b. Test environment, hardware, and software configurations used for each test.

    c. Date and time of each test-related activity, the identity of the individual(s) who performed the activity, and the identities of witnesses, as applicable.

4) Rationale for decisions.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-FLSW-08	Software Maintenance Manual

3. Use:

To provide information to aid in analyzing, debugging, modifying, testing and loading the software. This includes a description of any support hardware, software and tools required to maintain the software. The Software Maintenance Manual is not intended to provide a description of the software nor is it intended to provide instruction in how to program.

4. Preparation Information:

Contractor format acceptable.

The Software Maintenance Manual **shall** include the following information:

1) Description of the target hardware
2) Description of the operating system(s) used on the target hardware, including appropriate reference manuals.
3) Description of the compilers and linkers needed to maintain the software, including appropriate reference manuals.
4) Description of test tools needed to verify the software including appropriate reference manuals
5) Description of support software such as COTS systems that are integrated into the system.
6) Provide any technical details that are needed to modify or patch the software.
7) Describe any patches that currently exist. This includes listings of the source code and the procedures to compile, link, test, and load the patch.
8) h. Provide the procedures that are needed to build a new release of the software.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: SC-FLSW-09

2. Title: Software Preliminary Design Review (SWPDR) Data Package

3. Use:

Thoroughly describes the preliminary design, functional decomposition, and requirements traceability of Class B Software. Provides overall view of the software test program.

4. Preparation Information:

The SWPDR Data Package **shall** address:

1) Agenda
2) Status of any open action items generated at prior reviews
3) Presentation material for the subject review
4) Analyses and reports required at the review
5) Software design documentation and supportive design material in compliance with the Software Management Plan and Configuration Management Plan (e.g. software Requirements Specifications, Software Design Documents, Software Engineering Analyses, Use Case Analyses)
6) The architecture and design of the software, necessary to operate, test, and analyze the Spacecraft and its algorithms. This includes design specifications down to the CSC level.
7) Interfaces between the Spacecraft Flight Software and the Instruments, for all spacecraft modes. Include discussion of test and verification methods for these interfaces.
8) Software capability to provide all spacecraft operational modes
9) Status of any Safety Critical Software Requirements
10) Software required for data analyses utilizing the EGSE
11) Software for supporting spacecraft verification, integration, monitoring of performance, as well as supporting evaluation of data acquired during S/C integration
12) Providing and maintaining real-time and off-line software for spacecraft validation
13) Resource utilization estimates for each CSCI
14) Software Test Program; to include test philosophy objectives and rationale for all software testing and hardware/software integration activities planned for the program.
15) Approach to Command & Telemetry structure
16) Overview and status of GOES-R Class C, D, or E (non-flight) software efforts (e.g. EGSE software, FSDE

Effective Date: (Date of last signature)

Software, Emulator Software, and Test Software)

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-FLSW-10	Software Critical Design Review (SWCDR) Data Package

3. Use:

Thoroughly describes flight software detailed design and demonstrates that the detailed design satisfies the software and interface requirements. Defines test cases and demonstrates traceability of test procedures to requirements.

4. Preparation Information:

The SWCDR Data Package **shall** address:

1) Agenda
2) Status of any open action items generated at prior reviews
3) Presentation material for the subject review
4) Analyses and reports required at the review
5) Software design documentation and supportive design material.
6) All documentation as called for by the Software Management Plan
7) Updates of all items required for SWPDR
8) Definition of the test procedures and test case, to include all interface tests.
9) Final Software Requirements Specification allocated to the CSU level.
10) Resource utilization estimates for each CSCI
11) Description of the Command & Telemetry Format and Structure

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-FLSW-11	Flight Software Test Readiness Review (SWTRR) Data Package

3. Use:

Thoroughly describes the flight software development status and reviews test readiness prior to the start of formal verification testing.

4. Preparation Information:

The SWTRR Data Package **shall** address:

1) Agenda
2) Status of any open action items generated at prior reviews
3) Presentation material for the subject review
4) Analyses and reports required at the review
5) Supportive material. Where supportive material has been submitted prior to or concurrent with this requirement, such material may be incorporated within this requirement by reference.
6) All documentation as called for in the Software Management Plan
7) Failure report summaries including status of action and rationale for closure
8) As-built documentation summary
9) Overview of integration test results
10) Description of the formal testing to be performed
11) Overview of dry-runs of formal test procedures
    a. Overall assessment of the software as demonstrated by the test results
    b. Remaining deficiencies, limitations, or constraints detected by testing
    c. Impact of test environment

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-FLSW-12	Software Qualification Review (SWQR) Data Package

3. Use:

For review of all test data and designs for compliance against specification requirements, variances, mission operations requirements, etc. To ensure that all software loaded onto flight hardware is flight qualified.

4. Preparation Information:

An SWQR Data Package **shall** be delivered for all Class B Software.

This SWQR Data Package **shall** address:

1) Agenda
2) Responses to action items generated at prior reviews
3) Presentation material for the subject review
4) Analyses and reports required at the review
5) Supportive material. Where supportive material has been submitted prior to or concurrent with this requirement, such material may be incorporated within this requirement by reference.
6) Overview of Formal Test Results
    a. Overall assessment of the software as demonstrated by the test results
    b. Remaining deficiencies, limitations, or constraints detected by testing,
    c. Impact of test environment
7) Results of the functional and interface tests
8) Malfunctions and corrective actions Impact of test environment
9) Reliability predictions
10) Comparison of measured performance with requirements and discussion of the effect of any variance and waivers
11) Mission operation constraints
12) Safety requirements
13) Interface concerns, problems and solutions
14) Compatibility of instrument with observatory flight support equipment, ground support equipment and

operational ground equipment

15) Software Version Description

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-FLSW-13	Software Release Delivery Package

3. Use:

A software delivery package is required with submittal of each software release of flight software, FSDE software and/or Spacecraft Flight software for GSFC acceptance. There are three items comprising the software delivery package. The first item is the delivery letter describing what is being delivered. The second item is the software on appropriate media. The third item is accompanying documentation.

4. Preparation Information:

A Software Release Delivery Package **shall** be submitted with each software release for GSFC acceptance.

A Software Release Delivery Package **shall** be submitted with each software release for GSFC review.

The Software Release Delivery Package **shall** include the following information with appropriate approvals:

1) Software Delivery Letter, one page in length, which defines briefly what is being delivered, contains in its attachments the details of the delivery, and identifies a point of contact for resolution of questions/misunderstandings/problems involving the delivery. Attachments which support the delivery letter are described in items listed below:

    a. Description of Delivery Contents -Identify the delivery in terms of subsystem, release number(s), configuration ID(s), media type(s) (tapes, diskettes, other) and number of copies.

    b. Build Instructions -Provide instructions to be used in building the delivered software, including the version number of system or vendor-supplied software required to build the system. The supplier should provide evidence that these instructions have been executed prior to delivery and that the software has been built successfully using them (As Built Configuration).

    c. Special Operating Instructions -Indicate any special instructions that test or operations personnel need to know in using the software. These may include, for example, the use of special simulators, changes to operational procedures, the addition of new files, file format changes, operating constraints/limitations, workaround resolutions to documented problems, operational software version numbers, and associated database version numbers.

    d. List of Resolved Anomaly Reports and Change Requests.

    e. List of Unresolved Anomaly Reports and Change Requests.

    f. Copy of Resolved Anomaly Reports and Change Requests.

    g. Copy of Unresolved Anomaly Reports and Change Requests.

    h. Matrix of requirements addressed by this release (may be done by reference to mapping of requirements identified in requirements specification document).

i. Release History Summary Matrix.

j. Inventory of the Delivered Media -Produce the inventory from the media

k. themselves.

l. List of Release Documentation, e.g. users guide procedures.

2) Software Delivery Media. The software delivery will be delivered on media as agreed to by the contractor and the Government. The software product deliverable for each baseline Build should include, but not be limited to, the following:

a. Source Code

b. Object Code

c. Data

d. Executable Image

3) Accompanying Documentation. Provide updated copies of the following:

a. Software Version Description Document

b. Software Users Manual

c. Software Version Description Document

d. Software Design Document

e. Software Requirements Specification

f. Software Test Report

g. Software Maintenance Manual

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-FLSW-14	Software Delivery & Operations Transition Plan

3. Use:

To define the contractor's approach to preparing and delivering Class B software to the user's site(s). To define the contractor's approach for transitioning the operations of the software to the user.

4. Preparation Information:

A Software Delivery and Operations Transition Plan **shall** be delivered for all Class B software.

Contractor format acceptable.

The Software Delivery and Operations Transition Plan **shall** include the following:

1) A description of how the executable software for each user site, including any batch files, command files, data files, or other software files will be installed and operated on its target computer(s).

2) A description of how the source files will be transition to user site, including any batch files, command files, data files, or other software files will be installed and operated on its target computer(s).

3) A description of the documentation to be delivered with the software. This could include a Software Users Manual, Software Input/Output Manual, Software Maintenance Manual, Computer Operation Manual, or other support manuals.

4) A description of what activities will be done when installing the software at the user sites. This **shall** include the actual installation, checkout and any other activities that are required.

5) A description of the training program needed to for the successful transition of the software to the user.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-FLSW-15	Software Architecture Document

3. Use:

This document will be used to provide a top-level, conceptual design for all Class B software (which may consist of one or more CSCIs, CSCs, or CSUs) including major external and internal interfaces and logical data scheme. In addition, the document should describe the rationale for the architecture.

4. Preparation Information:

The Software Architecture document **shall** address all Class B software developed by the contractor for the GOES-R Program.

Contractor format is acceptable

The primary topics for the Software Architecture Document **shall** include:

1) Design Approach and Tradeoffs (If there are major design constraints imposed upon the software, identify and describe each of them.)

2) Conceptual Architecture Description

3) External Interface Concept

4) Traceability to Requirements

5) Partitioning for Incremental Development

6) Characteristics of the potential physical and organizational environment for the software.

7) The general flow of both execution control and data across external interfaces for the software, including hardware and networking considerations affecting software operation.

8) Anticipated data rates, processor and performance requirements, flexibility and expandability of the software, and development dependencies.

9) Description of the Computer Software Configuration items (CSCI). Present a further description of the Computer Software Components (CSC) if appropriate.

10) Estimated lines of code, amount of modified and reused code, estimated processor utilization, complexity, and risk for each CSCI. Distinguish clearly between software which execute in PROM, software that is copied from ROM to RAM for execution, and software that is only in volatile or non-volatile memory.

11) When discussing software reuse, show its applicability by presenting the similarity of requirements between the reuse program and GOES-R. Clearly distinguish between software design or code that is proven, and "future heritage". For "future heritage" software, report on the development process, test experience, and change history.

Effective Date: (Date of last signature)

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
SC-FLSW-16	Maintenance, Test, and Operations Manual for the Flight Software Development Environment

3. <u>Use:</u>

Provide information necessary to install, troubleshoot, and maintain the Flight Software Development Environment.

4. <u>Preparation Information:</u>

Contractor format acceptable.

The Maintenance, Test, and Operations Manual for the Flight Software Development Environment (FSDE) **shall** include the following:

1) Detailed vendor and custom equipment description, including a list of parts/devices.

2) Configuration of the final design including a set of reduced electrical schematics and top assembly mechanical drawings supporting the design and function description

3) Installation procedures.

4) Hardware maintenance resources.

5) Operation procedures.

6) Corrective maintenance procedures.

7) Preventive maintenance procedures.

8) Troubleshooting guide and error message descriptions.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:

SC-FLSW-17

2. Title:

Field Programmable Gate Arrays (FPGA) Development Plan

3. Use:

To document the contractor's systematic approach to, and processes used in, the management, design, development, testing (verification, validation, and qualification), documentation, configuration management, and quality assurance of any Field Programmable Gate Arrays (FPGAs).

4. Preparation Information:

The FPGA Development Plan **shall** apply to all FPGAs developed by the contractor for the GOES-R Program.

Contractor format acceptable.

The FPGA Development Plan **shall** include:

1) A description of practices, tasks, and activities performed as a basis for contractor effort and schedule determination.

2) A discussion of how FPGA functional and timing requirements are derived, documented, and verified.

3) A discussion of the selected FPGA part type(s), including selection justification.

4) A discussion of any plans for acquiring FPGAs and/or firmware, including intellectual property code and cores. Include a description of all subcontractor/vendor selection, management and/or monitoring.

5) A description of FPGA design, development and verification processes. Include a description of the processes and tools used for design capture (e.g. VHDL, Verilog, schematic), simulation, synthesis, and implementation (place & route).

6) A discussion of how the internal FPGA (peer) reviews fit into the FPGA development process, the instrument design reviews, and instrument development lifecycle. Indicate Quality Assurance (QA) and government notification and participation in FPGA reviews, where applicable.

7) A description of FPGA design guidelines, including guidelines for Logic Utilization by type (combinatorial, sequential, RAM, etc.), I/O Utilization and Timing Margins at various stages of development.

8) A Configuration Management section describing the configuration management process for FPGAs and their associated items (e.g. HDL source files, simulation scripts and stimuli, CAD tool configurations, netlists, etc.). Clearly define the relationship between the FPGA configuration management approach and that employed by the remainder of the project. This section should include:

    a. Configuration Identification

    b. Configuration Control

   c. Configuration Audits and Reviews

   d. FPGA Configuration Management tools and techniques

9) A discussion of QA involvement/monitoring/oversight/audit of FPGA development processes and their associated artifacts.

10) Provide an overall view of the FPGA test program, detailing validation/verification approach, test philosophy objectives, and rationale for all FPGA testing activities planned for the program.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u> **2. <u>Title:</u>**

SC-FLSW-18 Field Programmable Gate Arrays (FPGA) Design Data Package

3. <u>Use:</u>

An FPGA Design Data Package is required for each FPGA design to allow independent Government review and assessment of contractor FPGA designs.

4. <u>Preparation Information:</u>

The FPGA Design Data Package **shall** be submitted for each FPGA developed by the contractor for the GOES-R Program.

The FPGA Design Data Package **shall** include:

1) Box, board & FPGA requirements, specifications and/or presentations relevant to the FPGA
2) FPGA source code (VHDL or Verilog), schematics and/or state machines/tables, including any 3rd party intellectual property code and/or cores
3) Synthesis files (constraints & reports (.srr))
4) Actel database file (.adb) or equivalent file(s) if not an Actel FPGA
5) Simulation testbenches/scripts and coverage report
6) FPGA Place and Route Reports
7) CCA schematics (PDF and native format)
8) CCA parts list
9) CCA netlist
10) CCA layout (PDF and native format)
11) Signal integrity analysis results
12) Timing analysis results (external inputs and outputs, internal domain(s), internal domain crossings)

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-MAGN-01	Spacecraft Magnetic Control Plan for Magnetometer Performance Assurance

3. Use:

To ensure that no spacecraft (or spacecraft appendage) steady or time-varying field interferes with the spacecraft-provided magnetometer instrument meeting all required specification levels, as defined in the magnetometer performance specification, to measure the Earth's ambient magnetic field.

4. Preparation Information:

The Spacecraft Magnetic Control Plan for Magnetometer Performance Assurance **shall** identify and characterize all magnetic materials used in fabrication of spacecraft flight hardware, including those used in the magnetometer support structure.

The Spacecraft Magnetic Control Plan for Magnetometer Performance Assurance **shall** describe all spacecraft parts that move in the spacecraft frame of reference.

The Spacecraft Magnetic Control Plan for Magnetometer Performance Assurance **shall** state magnetic field corrections required for the magnetic signature of any spacecraft components such as magnetic torquer coils whose stray magnetic signature exceeds allowable limits.

The Spacecraft Magnetic Control Plan for Magnetometer Performance Assurance **shall** describe in detail the stray magnetic fields arising from current loops in the spacecraft subsystems, payloads, and the associated interconnection harnessing.

The Spacecraft Magnetic Control Plan for Magnetometer Performance Assurance **shall** quantify the impact of the stray magnetic fields arising from current loops in the spacecraft subsystems, payloads, and the associated interconnection harnessing, on the magnetometer sensor.

The Spacecraft Magnetic Control Plan for Magnetometer Performance Assurance **shall** tabulate estimated dipole moment, position and orientation and calculated field at the magnetometer sensor, for all spacecraft components known to possess significant magnetic material. This tabulation is derived from the spacecraft magnetic field model.

The Spacecraft Magnetic Control Plan for Magnetometer Performance Assurance **shall** quantify the impact of the stray magnetic fields arising from all elements of power generation and distribution, heaters, communications components, and subsystems whose status changes frequently, on the magnetometer sensor.

The Spacecraft Magnetic Control Plan for Magnetometer Performance Assurance **shall** describe the system level stray magnetic test that will be employed for the GOES-R program to demonstrate that each individual spacecraft module and the flight system as a whole comply with the specification on the stray magnetic field.

The Spacecraft Magnetic Control Plan for Magnetometer Performance Assurance **shall** allow permanent and soft magnetic materials only in the absence of documented non-magnetic alternatives.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
SC-MAGN-02	Spacecraft Magnetic Field Model

3. Use:

For predicting worst-case magnetic signature from the spacecraft body at the flight sensor assembly, as well as to estimate the worst-case spacecraft attitude perturbations caused by magnetic torque.

4. Preparation Information:

The Spacecraft Magnetic Field Model **shall** include dipole moment, position and orientation for all spacecraft subsystems known to possess significant magnetic material.

A correction scheme (algorithm) for the Spacecraft Magnetic Field Model **shall** be included and delivered for use by the NOAA Space Environment Center for use in real-time data processing to correct for any magnetic signature that exceeds magnetometer specification limits.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
GS-01	**Spacecraft Simulator Design Document**

3. Use:

To Provide documentation that can be used to understand the design and operation of the Spacecraft Simulator.

4. Preparation Information:

The Spacecraft Simulator Design Document shall describe the detailed design of the spacecraft simulator, including all hardware, software, firmware, and commercial-off-the shelf (COTS) test equipment used in the simulator.

Distinctions in the Spacecraft Simulator Design Document shall be made between flight-like components, simulated components, and full-software simulations.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: | **2. Title:**

1. CDRL No.:	**2. Title:**
GS-02	**Spacecraft / Instrument Interface Simulator Specification**

3. Use:

This specification establishes the performance, design, development, and test requirements for the Spacecraft/Instrument Interface simulator.

4. Preparation Information:

The format of the Spacecraft / Instrument Interface Simulator Specification is left to the contractor to define, subject to review by NASA/GSFC.

The Spacecraft / Instrument Interface Simulator Specification defines the functional and performance characteristics of the spacecraft interface simulator.

Spacecraft / Instrument Interface Simulator Specification sections shall include: Scope, Applicable Documents, Requirements, Performance Assurance Provisions, Preparation for Delivery, Notes, and Appendix.

Item identification and diagrams, interface definition, physical characteristics, design and construction requirements, and documentation in the Spacecraft / Instrument Interface Simulator Specification shall be covered.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
GS-03	**Spacecraft / Instrument Interface Simulator Drawings, Wiring, & Parts List**

3. <u>Use:</u>

The Spacecraft / Instrument Interface Simulator Drawings, Wiring, & Parts List is used with the fabrication and assembly of the spacecraft interface simulator.

4. <u>Preparation Information:</u>

The Spacecraft / Instrument Interface Simulator Drawings, Wiring, & Parts List shall fully describe the design of the named hardware item(s), with all drawings necessary for fabrication, assembly, and test thereof.

Mechanical assembly and detail drawings, Logic and/or schematic diagrams, parts lists, harness drawings, wire connection lists, and any unique process specifications are identified as needed in the Spacecraft / Instrument Interface Simulator Drawings, Wiring, & Parts List

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
GS-04	**Spacecraft Simulator User's Operations and Maintenance Manual**

3. Use:

Used by the government to setup, use, troubleshoot, repair, and modify the spacecraft simulator.

4. Preparation Information:

The Spacecraft Simulator User's Operations and Maintenance Manual can be delivered in multiple volumes and shall be delivered in electronic format.

The user data and operator data in the Simulator User's Operations and Maintenance Manual shall feature pull down help menus.

The maintenance data in the Spacecraft Simulator User's Operations and Maintenance Manual shall be password protected.

The data required for the Spacecraft Simulator User's Operations and Maintenance Manual shall be divided into three main categories; user data, operator data and maintenance data, as detailed below

1) **USER DATA**
   a. **Description of Capabilities -describes features, capacities, and limitations of the simulator and its displays**

   b. **Normal configuration and use -step by step menu of exact steps needed to bootstrap the simulator, including error avoidance and recovery.**

   c. **Saving Simulation Status -method by which user can suspend the simulation for future use.**

   d. **Fast Forwarding -describe how to run simulator in other than real time. Discusses constraint on non-realtime simulations.**

   e. **Test Modes -delineates all possible operational modes of the simulator.**

   f. **Graphics interfaces -complete description of operation of all graphics available to the simulator**

2) **OPERATOR DATA**
   a. **Simulator Component Interfaces -describes each and every component within the simulator and shows how it interfaces to the ground system.**

   b. **Modes of Operation -detailed description of all mode of operation of the simulator and the appropriate display pages.**

   c. **Anomaly Modeling -describes the types of anomalies that can be simulated and the means of producing them.**

3) **MAINTENANCE DATA**

a. Requirements Specification -the complete specifications provided to the designers of the simulator.

b. Detailed Design Document -all documentation on the final design including system architecture, platform selection criteria, module connectivities, error-handling capabilities, system expansion methodology, and user interfaces.

c. Hardware Design and Specification -all documentation used in the selection, fabrication, installation, and integration of the hardware components of the simulator.

d. Acceptance Test Plan, Procedures, and Reports -all documentation regarding acceptance of the simulator including results of all test performed, all procedures run against the simulator and the final report accepting the simulator.

e. Version Description Document -precise report for each new build of the simulator describes each change to the simulator hardware or software, including reason for change request, date requested and date released.

4) TRAINING

a. The spacecraft contractor shall provide training and training materials in conjunction with modified and new ground system elements

b. Training documentation shall include

i. Training Plan

ii. User/Operator Training and Users Manuals

c. User documents to support all deliverable SDVE tools. COTS users documents are sufficient where applicable.

5) The spacecraft contractor shall conduct simulator training for approximately 10 government simulator support personnel.

6) Training classes and materials shall be developed in accordance with the General Requirements for Training on Electronic Equipment.

7) Training shall be completed no later than two weeks after completion of PSR.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
GS-05	**Software Development & Validation Simulation Drawings, Wirings, and Parts List**

3. <u>Use:</u>

It is used to identify and depict all components and parts of the Flight operations training/software Development and Validation simulator.

4. <u>Preparation Information:</u>

The Software Development & Validation Simulation Drawings, Wirings, and Parts List shall contain complete drawings with parts lists and applicable specifications noted.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
IT-01	Spacecraft Integration & Test Plan

3. Use:

The Spacecraft Integration and Test Plan provides lower level implementation details as defined and documented in the Program Verification and Validation Plan. The Spacecraft Integration and Test Plan is developed to track the verification requirements that must be satisfied to ensure a successful Integration & Test program. The plan defines the I&T test flow, test matrices, any program specific test requirements and provides the basis of the verification program

4. Preparation Information:

The Spacecraft Integration and Test Plan **shall** include the following information:

- Provides initial verification requirements and compliance from the SCMAR, ICDs, SOW, F&PS, GFSC-STD-1000, etc.
- I&T Test Flow
    - Pre-Environmental
    - Environmental
        - EMI/EMC
        - Mechanical (Vibration, Acoustics, Shock)
        - Magnetic
        - SCTV
    - Post-Environment
- I&T Test Matrix (Test Phase vs. Test Procedure)
    - Defines CPT and LPT test performed
    - Defines performance testing
    - Identifies where redundant strings are tested
    - Identifies where and when alignment measurements and surveys and deployment tests are performed
- Describes Test Phase entry/exit criteria
- Describes Test Readiness Review and Post Test Review Processes
- Describes Verification Requirement method from unit to Spacecraft
    - Qualification, Proto-flight, Acceptance
- Identify any Life Test Plans
- Defines System and Segment Tests Test Objectives and Initial Plan

Effective Date: (Date of last signature)

  - ETE
  - Ground Compatibility
  - INR
  - EMI/EMC
- Describes ESD, EMI/EMC and Contamination Control Plans
- Describe the facility requirements including any program specific facility requirements
- Defines Performance Trending Parameters
- Initial Launch I&T Test Flow and Plan

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: **2. Title:**

IT-02 Spacecraft Launch Site Integration Plan (LSIP)

3. Use:

The LSIP details all planned activities required to perform Spacecraft Launch Base I&T through Spacecraft final pre-launch/countdown preparations. The LSIP identifies Spacecraft support requirements and provides the basis for transmittal of all GOES requirements to ER for their use in preparation of the Launch Site Support Plan, and supporting payload requirement documents.

4. Preparation Information:

The LSIP **shall** define and document the support activities that are necessary for pre-launch I&T activities and the technical aspects of launch operations. All launch base facilities utilized for Spacecraft I&T, support services and materials must be specified in this document. GFP facility utilization and support requirements should be identified as applicable.

The LSIP **shall** document compliance with all ER safety training, security and Personal Reliability Program requirements.

Contractor Defined Format.

The LSIP **shall** include:

- 1.0 General
  - 1.1 Plan Organization
  - 1.2 Plan Scope
  - 1.3 Applicable documents [Include: Itemized Procedure List w/ Hazardous/Non-Haz. Designation]
  - 1.4 Spacecraft Hazard System Summary
- 2.0 Launch Site Management
  - 2.1 Organization
  - 2.2 Astrotech Processing Facility / Control Room / Office : Assignments
  - 2.3 Meetings
  - 2.4 Schedule –Master Schedule
- 3.0 Pre-launch/Launch Test Operations Summary
  - 3.1 Schedule –Daily/Shift Detailed Schedule
  - 3.2 Layout of Equipment (EGSE/MGSE/Flight Hardware)
    - 3.2.1 Test Flow Depiction –Identify staging transitions for subject hardware as a function of processing schedule events
  - 3.3 Description of Events at Launch Site

3.3.1 Spacecraft Delivery/Receipt Operations

3.3.2 Standalone Payload Processing Facility Operations (Non-Hazardous / Hazardous)

3.3.2.1 SC Electrical I&T

3.3.2.2 SC Mechanical I&T

3.3.2.3 SC Propulsion I&T

3.3.2.4 Contamination Control Activities

3.3.2.5 GFP I&T

3.3.2.6 ETE Testing (As Applicable)

3.3.2.7 Launch Countdown Rehearsals (As Applicable)

3.3.2.8 Spacecraft Inspections and Closeouts

3.3.3 Integrated Payload Processing Facility Operations

3.3.3.1 SC Mate with LV Adapter

3.3.3.2 SC Post-Mate Testing

3.3.3.3 SC Encapsulation

3.3.3.4 SC Post-Encapsulation Testing

3.3.3.5 Encapsulated SC Transportation Operations

3.3.4 Launch Complex Operations

3.3.4.1 SC Preparations for Pad Operations

3.3.4.2 Post Mate Electrical Testing

3.3.4.3 SC Mechanical Activities (As applicable)

3.3.4.4 SC Closeout Activities (As applicable)

3.3.4.5 SC Launch Countdown Support

3.4 SC Launch Hold Criteria

3.5 SC Environmental Requirements

3.4.1 Astrotech Facility Requirements (Include 10K Operations Identification)

3.4.2 Pad Transport Operations

3.4.3 Post-Mate Payload Fairing

4.0 Contingency Operations

4.1 Hurricane Contingency

4.1.1 Pre-Encapsulation

4.1.2 Post-Encapsulation

4.2 Lightning Strike Contingency

4.3 Propellant Offload Contingency

5.0 Personnel Training Requirements and Certifications

Effective Date: (Date of last signature)

6.0 Security

7.0 Safety

8.0 Special Support Requirements

8.1 Communications (Voice/Video)

8.2 Command / Telemetry

8.3 Contamination Control (e.g. Purge Support Requirements)

8.4 GSE Handling & Transport (e.g. ASO to Pad)

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
IT-03	Spacecraft Launch Commit Criteria

3. Use:

The Spacecraft Launch Commit Criteria is the governing list for determining when a launch delay must be called, and should be strictly enforced.

4. Preparation Information:

The Spacecraft Launch Commit Criteria (SLCC) **shall** document the criteria to be used to commit the GOES-R spacecraft for launch.

The SLCC **shall** include criteria for the spacecraft, GFP instruments, the spacecraft launch control center(s), launch critical GSE and associated activities prior to liftoff.

One or more violations of SLCC abort limits are mandatory for a SC launch abort. Non-SLCC Out of Spec readings that do not violate the abort criteria, can, at the discretion of the Mission Director, be a cause for a launch scrub.

The SLCC abort criteria for GOES **shall** include but is not limited to the following guidelines:

- Anything that could result in unacceptable risk to the long term health and safety of the spacecraft
- Anything that could result in significant loss of redundancy of major subsystems and/or instruments
- Anything that is would result in either of the above items if current trending continued.

The SLCC spacecraft configuration for launch **shall** be monitored via real-time telemetry.

Each SLCC telemetry parameter **shall** be tabulated with its acceptable values, tolerances, trending patterns, and out-of-limits conditions which would require a resolution prior to launch.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
IT-04	Subsystem Level Test Plans

3. Use:

The Test Plan provides an overall description of the GOES-R test program for the designated subsystem, at the Subsystem level of test.

4. Preparation Information:

Hard Copy / Electronic Copy

Select Subsystems in the Subsystem Level Test Plans **shall** be for "Approval" identified at CDR +60 days; Remainder **shall** be for "Review".

The Subsystem Level Test Plans **shall** define and document the specific tests and verification methodologies (Test/Analysis/Inspection/Similarity) that collectively demonstrate that the hardware/software is in compliance with the applicable performance specifications and programmatic requirements.

Contractor Defined Format

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
IT-05	Bus/Spacecraft Level Test Plans

3. Use:

The Test Plan provides an overall description of the GOES-R test program for the designated subsystem, at the Bus/Spacecraft level of test pre GFP instrument integration.

4. Preparation Information:

Hard Copy / Electronic Copy

Select Subsystem **shall** be for "Approval" identified at CDR +60 days; Remainder **shall** be for "Review".

The Bus/Spacecraft Level Test Plan **shall** define and document the specific tests and verification methodologies (Test/Analysis/Inspection/Similarity) that collectively demonstrate that the hardware/software is in compliance with the applicable performance specifications and programmatic requirements.

Contractor Defined Format

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
IT-06	Satellite Level Test Plans

3. Use:

The Test Plan provides an overall description of the GOES-R test program for the designated subsystem, at the Satellite level of test (GFP instruments integrated).

4. Preparation Information:

Hard Copy / Electronic Copy

Select Subsystem **shall** be for “Approval” identified at CDR +60 days; Remainder **shall** be for “Review”.

The Satellite Level Test Plan **shall** define and document the specific tests and verification methodologies (Test/Analysis/Inspection/Similarity) that collectively demonstrate that the hardware/software is in compliance with the applicable performance specifications and programmatic requirements.

Contractor Defined Format

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u> IT-07

2. <u>Title:</u> Subsystem Level Test Procedures

3. <u>Use:</u>

The Test Procedure documents the step by step testing process, for the designated subsystem, performed to verify compliance with applicable performance specifications and programmatic requirements.

4. <u>Preparation Information:</u>

Hard Copy / Electronic Copy

Select Subsystem **shall** be for "Approval" identified at CDR +60 days; Remainder **shall** be for "Review".

The contractor **shall** provide detailed Subsystem Level Test Procedures, for the designated subsystem, at the Subsystem level of test.

Subsystem Level Test Procedures **shall** also be developed in support of the ETE test program, as a means for establishing the test configuration required by the applicable ETE test.

Contractor Defined Format.

As a minimum, the Subsystem Level Test Procedures **shall** contain the following information:

1) Test Objectives
2) Test Methods
3) Applicable Documents and Software
4) Required Spacecraft Configuration
5) Test Equipment Configuration
6) Test Equipment Identification
7) Test Instrumentation
8) Safety Provisions and Cautions
9) Program Quality Requirements
10) Detailed Test Instructions
11) Data Recording Requirements
12) Data Recording Forms and Tables
13) Accept/Reject Criteria per Documented Test Requirement

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: **2. Title:**

IT-08 Bus/Spacecraft Level Test Procedures

3. Use:

The Test Procedure documents the step by step testing process, for the designated subsystem, performed to verify compliance with applicable performance specifications and programmatic requirements.

4. Preparation Information:

Hard Copy / Electronic Copy

Select Subsystem **shall** be for "Approval" identified at CDR +60 days; Remainder **shall** be for "Review".

The contractor **shall** provide detailed test procedures, for the designated subsystem, at the Bus/Spacecraft level of test.

Bus/Spacecraft Level Test Procedures **shall** also be developed in support of the ETE test program, as a means for establishing the test configuration required by the applicable ETE test.

Contractor Defined Format.

As a minimum, the Bus/Spacecraft Level Test Procedures **shall** contain the following information:

1) Test Objectives
2) Test Methods
3) Applicable Documents and Software
4) Required Spacecraft Configuration
5) Test Equipment Configuration
6) Test Equipment Identification
7) Test Instrumentation
8) Safety Provisions and Cautions
9) Program Quality Requirements
10) Detailed Test Instructions
11) Data Recording Requirements
12) Data Recording Forms and Tables
13) Accept/Reject Criteria per Documented Test Requirement

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
IT-09	Satellite Level Test Procedures

3. Use:

The Test Procedure documents the step by step testing process, for the designated subsystem, performed to verify compliance with applicable performance specifications and programmatic requirements.

4. Preparation Information:

Hard Copy / Electronic Copy

Select Subsystem **shall** be for "Approval" identified at CDR +60 days; Remainder **shall** be for "Review".

The contractor **shall** provide detailed test procedures, for the designated subsystem, at the Satellite level of test.

Satellite Level Test Procedures **shall** also be developed in support of the ETE test program, as a means for establishing the test configuration required by the applicable ETE test.

Contractor Defined Format.

As a minimum, the Satellite Level Test Procedures **shall** contain the following information:

1) Test Objectives
2) Test Methods
3) Applicable Documents and Software
4) Required Spacecraft Configuration
5) Test Equipment Configuration
6) Test Equipment Identification
7) Test Instrumentation
8) Safety Provisions and Cautions
9) Program Quality Requirements
10) Detailed Test Instructions
11) Data Recording Requirements
12) Data Recording Forms and Tables
13) Accept/Reject Criteria per Documented Test Requirement

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: **2. Title:**

IT-10 Subsystem Level Post-Test Data Package

3. Use:

The Post-Test Data Package provides a comprehensive record which documents/summarizes the results of the as-run test procedure. The Post-Test Data Package identifies which test objectives were accomplished, how well predicted performance was validated by the test data, and annotates any other significant events which occur during testing.

4. Preparation Information:

Hard Copy / Electronic Copy

The contractor **shall** evaluate the data taken during spacecraft integration and test for conformance with applicable spacecraft performance specifications and programmatic requirements.

The contractor **shall** provide a detailed Subsystem Level Post-Test Data Package, for the designated subsystem, at the Subsystem level of test.

Contractor Defined Format.

As a minimum, the Subsystem Level Post-Test Data Package **shall** contain the following information:

1) Copy of As Run Test Procedure
2) Evidence of Quality Assurance acceptance data
3) Listing of test requirements verified
4) Summary description and commentary on the test data package
5) Test procedure change record listing
6) Data trending
7) Material review actions resulting from the tests
8) Test equipment calibration data (Not required for routine test equipment calibrations)
9) Anomaly report listing and copies (Including status/resolution if completed by submittal)
10) Unit Failure Free / Limited Life Time Accounting

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: IT-11

2. Title: Bus/Spacecraft Level Post-Test Data Package

3. Use:

The Post-Test Data Package provides a comprehensive record which documents/summarizes the results of the as-run test procedure. The Post-Test Data Package identifies which test objectives were accomplished, how well predicted performance was validated by the test data, and annotates any other significant events which occur during testing.

4. Preparation Information:

Hard Copy / Electronic Copy

The contractor **shall** evaluate the data taken during spacecraft integration and test for conformance with applicable spacecraft performance specifications and programmatic requirements.

The contractor **shall** provide detailed test data packages, for the designated subsystem, at the Bus/Subsystem level of test.

Contractor Defined Format.

As a minimum, the Bus/Spacecraft Level Post-Test Data Package **shall** contain the following information:

11) Copy of As Run Test Procedure
12) Evidence of Quality Assurance acceptance data
13) Listing of test requirements verified
14) Summary description and commentary on the test data package
15) Test procedure change record listing
16) Data trending
17) Material review actions resulting from the tests
18) Test equipment calibration data (Not required for routine test equipment calibrations)
19) Anomaly report listing and copies (Including status/resolution if completed by submittal)
20) Unit Failure Free / Limited Life Time Accounting

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
IT-12	Satellite Level Post-Test Data Package

3. Use:

The Post-Test Data Package provides a comprehensive record which documents/summarizes the results of the as-run test procedure. The Post-Test Data Package identifies which test objectives were accomplished, how well predicted performance was validated by the test data, and annotates any other significant events which occur during testing.

4. Preparation Information:

Hard Copy / Electronic Copy

The contractor **shall** evaluate the data taken during spacecraft integration and test for conformance with applicable spacecraft performance specifications and programmatic requirements.

The contractor **shall** provide detailed test data packages, for the designated subsystem, at the Satellite level of test.

Contractor Defined Format.

As a minimum, the Satellite Level Post-Test Data Package **shall** contain the following information:

21) Copy of As Run Test Procedure

22) Evidence of Quality Assurance acceptance data

23) Listing of test requirements verified

24) Summary description and commentary on the test data package

25) Test procedure change record listing

26) Data trending

27) Material review actions resulting from the tests

28) Test equipment calibration data (Not required for routine test equipment calibrations)

29) Anomaly report listing and copies (Including status/resolution if completed by submittal)

30) Unit Failure Free / Limited Life Time Accounting

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
IT-13	Transportation and Handling Plan & Procedures

3. Use:

The Transportation and Handling Plan and Procedure define and document the process for handling and transporting the Spacecraft, GSE, and flight spares during integration and test activity, through transportation to the Eastern Range (ER) for Launch Base Processing.

4. Preparation Information:

Hard Copy / Electronic Copy

A. TRANSPORTATION & HANDLING PLAN

The Transportation and Handling Plan **shall** incorporate details of the spacecraft and GSE during the integration and test flow sequence and the transportation from the contractor's plant to the ER.

Requirements for air or ground shipment **shall** be specified in the Transportation and Handling Plan.

The Transportation and Handling Plan shipping plan **shall** include all necessary planning and paperwork to support the transportation.

Contractor Defined Format.

The Transportation and Handling Plan **shall** include the following:

1) Ground and/or air shipment cargo loading and unloading procedures.
2) Cargo manifest including aircraft layout diagrams.
3) Staging area plans and diagrams.
4) Trip planning schedule of events, required support, route, contingency plans, permits.
5) Loading/unloading GSE and personnel required.
6) Requirements for pertinent calibration, special tools, fixtures, shipping containers, etc.
7) Transportation and handling flow plan for the spacecraft during manufacture, integration, testing and launch activity.

B. TRANSPORTATION & HANDLING PROCEDURE

The Transportation & Handling Procedures **shall** specify all of the step-by-step procedures for the handling and transporting of the Spacecraft, GSE, and flight spares.

Contractor Defined Format.

The Transportation & Handling Procedures **shall** include:

1) Special environmental conditions, such as cleanliness, temperature, humidity, etc.

2) Format for recording QA stamp, deviations, and approval columns.
3) Requirements for special tools, equipment, special handling fixtures, and containers.
4) Procedures to comply with local, state, and federal safety requirements.
5) Procedures for maintaining contact with the transported item (where applicable).

C. TRANSPORTATION LOG, AND PRE-SHIPMENT COORDINATION

The spacecraft contractor **shall** maintain a log of events and periodic environmental readings throughout all transportations.

The time of significant and major events and unexpected environmental readings **shall** be recorded.

All unexpected events **shall** be evaluated for their possible negative impact on the spacecraft and a discrepancy report **shall** be generated if considered to possibly affect spacecraft performance.

The spacecraft contractor **shall** conduct pre-shipment coordination meetings with all involved parties at the plant, departing facility, and airport.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: IT-14

2. Title: Ground Storage Plan

3. Use:

This document provides the plan for implementing ground storage of the GOES-R Spacecraft.

4. Preparation Information:

The Ground Storage Plan **shall** describe the following:

1) The stage in the S/C acceptance test flow sequence at which the S/C would be placed into ground storage.
2) Spacecraft ground storage configuration, including which components (if any) would be removed for separate storage.
3) Ground storage containers and environment and the associated instrumentation for monitoring the S/C and environment during storage.
4) The schedule and extent of S/C testing and inspection during ground storage. An annual test of selected spacecraft and instruments is required.
5) Flight battery certification plan with the effects of the storage period on the expected in-orbit lifetime.
6) Impact of prolonged storage on S/C operational lifetime including expendables.
7) Removal from storage, including retesting requirements.
8) A plan for maintaining the readiness of the system test equipment, and Ground Support Equipment.
9) The management plan for insuring availability of facilities and experienced personnel to support the storage and post-storage activities. This plan **shall** include but is not limited to training in these areas:
    - Instrument Test and STE operation
    - Assembly, Integration and Test Personnel for GOES specific support
    - Spacecraft System Post-Storage Integration and Test
    - Spacecraft Thermal Vacuum (SCTV) Test
    - End To End Test
10) The procedures and documentation plan for handling discrepancies and malfunctions found prior to and during the storage period.
11) The call-up and activation plan and schedule with milestones and event span-times that will be followed after receipt of direction to remove the S/C from storage to meet a selected launch date.
12) The Ground Storage Plan **shall** incorporate the storage and test requirements for the GFP instruments.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: IT-15

2. Title: Performance Trending Plan

3. Use:

The Performance Trending Plan defines and documents the plan for trending unit and subsystem level performance data throughout the Integration and Test phase of the program.

4. Preparation Information:

The Performance Trending Plan **shall** contain performance data trended throughout the I&T phase of the program

- Critical test data parameters will be identified based on previous program experience, defined requirements, and identification by subsystem engineering of derived requirements
- The spacecraft contractor will develop a database with critical parameters defined to track and trend performance
- Threshold values and alarm limits, were applicable, are set in the database and tracked by the spacecraft contractor during testing. Any changes to these values and limits will be coordinated with GSFC.
- At the end of each test, performance data from the test, is provided to the subsystem engineer for review and trending
- After each major phase, a post-test review is held to discuss the results of testing and review any issues, including critical parameter trending
- The spacecraft contractor will incorporate the data into the database to maintain accurate trending of the data. The database should be available for review on a continuous basis.
- When data is identified as being out of family or out of family, the spacecraft contractor will initiate an investigation to determine the cause and resolution of the anomaly

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
IT-16	Major Test Event (MTE) Development I&T Working Group Data Package

3. Use:

The Major Test Event (MTE) Development I&T Working Group Data Package contains information to be utilized by the I&T Working Group to facilitate test phase planning and development efforts.

4. Preparation Information:

The Contractor **shall** provide electronic copies of the Data Package 2 weeks prior to the initial MTE Development I&T Working Group meeting.

This CDRL item is required for the initial MTE Development I&T Working Group meeting only. Discussion/planning material required to support the subsequent MTE meeting **shall** be determined by the Contractor/Government team, and handled as a matter of course in preparation for that meeting.

Contractor Defined Format.

The Contractor **shall** provide the following material in the Major Test Event (MTE) Development I&T Working Group Data Package :

1) Detailed MTE schedule.
2) Test flow diagrams should be used to depict sequencing and flow (e.g. Launch Base I&T flow -Flight and ground hardware staging timeline).
   a. Proposed parallel test activities identified
   b. Proposed “quiet time” periods identified (e.g. ABI Power Profile test requires quiet bus operation)
3) Identification and status of all applicable documentation.
   a. I&T procedures.
   b. Facility operating procedures & certifications as applicable.
   c. Open anomaly reports (or equivalent) being carried into the subject test phase, including the identification of constraining anomaly reports (or equivalent).
4) Test Responsibilities –Identify Organization/POC responsible for test planning, test conducting, data acquisition/reduction, and test reporting. Include discussion of government/GFP team integration into this structure.
5) Test Facility Status
   a. GSE
      i. Functional drawings of proposed EGSE / Flight Hardware / Test Targets (as applicable) / Test Facility interconnects **shall** be provided.
      ii. GFP EGSE/MGSE staging –Information including floor-space dimensions, identification of power, grounding, timing signal services, and identification of GN2 purge and pneumatic services **shall** be provided.

1. Proposed GFP Cable/Harness routing with connector interface part numbers identified. Identification of test specific dimensional information including penetration dimensions, cable run lengths, specific shielding requirements –as applicable, and contamination control requirements should be included.

iii. Status of any test equipment in design/fabrication (e.g. test harnesses, lifting fixtures)

b. GSE calibration/proof plan & status –Itemized list of GSE and current calibration/proof status, with the go-forward plan as applicable.

c. Required Facility modification status –As applicable.

d. Facility Utilization schedule [Conflict resolution].

e. Test specific contamination control requirements -Planning / status.

f. Test specific instrumentation status –Availability / Installation schedules / Data Acquisition System functional interface drawings / Data evaluation capabilities and availability to the government team.

6) Identification of test hazards, restrictions, and controls

7) Emergency procedure guidelines –Discuss emergency handling procedures, and implications for powered spacecraft and GFP instruments.

8) Staffing plan, including proposed work schedule definition (test day/shift definition).

9) Identification of required personnel training and/or certifications.

10) Identification of Test Phase exit criteria –Break of Configuration requirements.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
IT-17	Test Readiness Review Data Package

3. Use:

Prior to each major test phase (bus/payload integration, environments, etc) or regression test during spacecraft I&T, the spacecraft contactor will conduct a briefing to determine the readiness to start a phase. The government reserves the right to require a test readiness review for other tests (Safe to Mate, anomaly resolution, etc) The test readiness briefing and all updates will be documented.

4. Preparation Information:

The Test Readiness Review Data Package **shall** include but is not limited to the following items:

1) Test Procedures to be performed during the phase and their status
2) Test data to be collected and trending of prior test data
3) Test anomalies status and their resolution or plan for closure as well as which ones must be closed prior to the start of testing
4) Summary of test requirements to be satisfied during this phase
5) Facility and EGSE readiness to support testing and any issues.
6) Manpower support
7) Test Schedule
8) Action Items from previous test/reviews with impact to start of testing

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u> | **2. <u>Title:</u>**

IT-18 | Post Test Data Review Package

3. <u>Use:</u>

The spacecraft contractor **shall** conduct a briefing of the test results following the completion of each major phase or regression test during spacecraft I&T. The government reserves the right to request a post test data review for additional selected tests. This briefing and any updates will be documented.

4. <u>Preparation Information:</u>

The Post Test Data Review Package **shall** cover at least the following items:

1) Test Procedures performed during the phase
2) Test data collected and trending with prior test data
3) Test anomalies and their resolution or plan for closure
4) Summary of test requirements satisfied during this phase
5) Facility and EGSE issues that affected the test
6) Summary of test performance and schedule
7) Plan for next phase activities
8) Action Items

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
IT-19	GFP Instrument Safe-To-Mate Test Plan

3. Use:

The GFP instrument Safe-To-Mate Test Plan provides the implementation details required for the successful electrical integration of the GFP instruments on the spacecraft. The plan defines the test procedures required for the GFP/spacecraft interface signal characterization test (first spacecraft only) and interface signal Safe-To-Mate test (all spacecraft).

4. Preparation Information:

Contractor Defined Format

The GFP Safe-To-Mate Test Plan **shall** include the following information:

- Provides verification requirements and compliance from the SCMAR, GFP to Spacecraft ICDs, SOW, and F&PS
- Verification that all the spacecraft/GFP interface signals (primary and redundant) are safe-to-mate tested for voltage, isolation and grounding. The resulting test procedure will be used on all spacecraft.
- Description of the method and the test equipment required to characterize the Spacewire GFP/spacecraft interface signals. The parameters of these interface signals to be characterized will be determined through agreement between the government, the spacecraft contractor, and the instrument provider. The resulting test procedure will apply only to the first spacecraft.
- Test procedures will be developed by the spacecraft contractor in collaboration with GFP contractors and government personnel.
- Test Readiness Review and Post Test Review Processes
- Describe the facility requirements for the tests (e.g. clean room, specific GFP handling).

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
IT-20	Spacecraft/Launch Vehicle Interface Requirements Document (IRD)

3. Use:

The Spacecraft to Launch Vehicle Interface Requirements Document (IRD) is designed to provide the spacecraft requirements definition, interface details, launch site facilities, and safety data necessary to interface with the launch vehicle. It defines the mission requirements and interfaces as they are known. It should also include any other government furnished hardware and services required such as transportation, propellants or analytical support services, facility utilization, as applicable.

4. Preparation Information:

Hardcopy / Electronic Copy

The Spacecraft/Launch Vehicle Interface Requirements Document (IRD)**hall** document all mission-peculiar requirements.

Spacecraft IRD inputs will form the basis for the development of the SC/LV ICD.

The format for Spacecraft/Launch Vehicle IRD **shall** be as follows:

1 INTRODUCTION & SCOPE (Includes mission and S/C description)
2 APPLICABLE DOCUMENTS
3 INTERFACE REQUIREMENTS
3.1 MECHANICAL INTERFACES
3.1.1 Structural Interfaces
3.1.1.1 Coordinate Systems
3.1.1.2 LV Payload Static Envelope
3.1.1.3 Hardware Clearances
3.1.1.4 Separation System Clearances
3.1.1.5 S/C Access Requirements
3.1.1.6 S/C Purge Interface
3.1.2 Structural Loads
3.1.2.1 Stiffness (S/C Frequency)
3.1.2.2 Interface Load Factors
3.1.2.3 Interface Loads
3.1.2.4 Strength
3.1.3 Mass Properties
3.1.3.1 S/C Mass Properties
3.1.3.2 S/C Propellant Data (for slosh analysis, etc.)
3.2 ELECTRICAL INTERFACES
3.2.1 Airborne Interfaces
3.2.1.1 Electrical Connectors
3.2.1.2 Electrical Interface Constraints (Separation Deadfacing)
3.2.1.3 Separation Verification
3.2.1.4 Telemetry Interfaces

3.2.1.5 Instrumentation & Instrumentation Telemetry Requirements
3.2.1.6 RF Link Interfaces
3.2.1.7 Discrete Command Interfaces
3.2.1.8 Airborne Power Interfaces
3.2.2 GSE Interfaces
3.2.2.1 Umbilical Interfaces
3.2.2.2 GSE Electrical Interface Constraints (Liftoff Deadfacing)
3.2.3 Telemetry/Command/Data Interfaces
3.2.4 Grounding
3.2.4.1 S/C Grounding
3.2.4.2 Support Equipment & GSE Grounding
3.2.4.3 Personnel Grounding
3.2.4.4 Grounding Continuity
3.3 ENVIRONMENTAL INTERFACES
3.3.1 Thermal Interfaces
3.3.1.1 Ground Transport Temperature & Humidity
3.3.1.2 Launch Pad A/C Temp, Humidity & Flow Rate
3.3.1.3 Flight Payload Fairing Temperatures
3.3.1.4 PLF Jettison Free Molecular Heating & Dynamic Pressure
3.3.1.5 Parking Orbit Free Molecular Heating
3.3.2 Contamination
3.3.2.1 Contamination Sensitive Surfaces
3.3.2.2 Deposition & Non-volatile Residue Requirements
3.3.2.3 LV Hardware Cleaning
3.3.2.4 LV Materials Control
3.3.2.5 S/C Transport Purges
3.3.2.6 S/C Launch Pad Purges
3.3.2.7 LV Debris
3.3.2.8 Helium Sensitivity
3.3.3 Pressure
3.3.3.1 Pressure Profile
3.3.3.2 Pressure Decay Rate
3.3.3.3 A/C Impingement Velocities
3.3.4 Dynamic Environments
3.3.4.1 Acoustics
3.3.4.2 Vibration
3.3.4.3 Shock
3.3.5 Electromagnetic Compatibility
3.3.5.1 EMI Safety Margin
3.3.5.2 Radiated Emissions Compatibility/Susceptibility (S/C, LV & Range RF Sources)
3.3.5.3 Lightning Protection
3.3.5.4 Interface Electrical Bonding
3.4 FLIGHT DESIGN INTERFACES
3.4.1 Launch Vehicle Performance
3.4.2 Parking Orbit (Perigee Altitude, Thermal Roll Requirements)
3.4.3 Transfer Orbit (Perigee Altitude, Injection Accuracy)
3.4.4 Launch Period/Windows
3.4.5 Sequence Requirements (S/C Events During Launch Sequence)
3.4.6 Separation Requirements (Attitude, Spin Rates, Angular Rates, Separation Velocity, LV

Attitude Control Inhibit)
3.4.7 Post Separation Requirements (CCAM, Attitude Control Inhibits)
3.5 FLIGHT OPERATIONS INTERFACES
3.5.1 Telemetry & Tracking
3.5.2 Acquisition Assistance (Orbital Parameter Message, State Vectors)
3.6 GROUND OPERATIONS
3.6.1 Facility Requirements (PPF/HPF, Blockhouse/LCC, Launch Pad)
3.6.2 Transport Requirements
3.6.3 Environmental Control/Purges
3.6.4 Communications
3.6.5 Propellants, Fluids & Gases
3.7 SAFETY REQUIREMENT
3.7.1 Safety Design Requirements
3.7.2 Hazardous Systems/Elements
3.7.3 Hazardous Operations

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
IT-21	Spacecraft Mission Insignia

3. Use:

For application to the Launch Vehicle for each GOES-R launch.

4. Preparation Information:

Electronic Copy

For the Spacecraft Mission Insignia dimensional information regarding the available footprint for this application, as well as the application location on the Launch Vehicle, in LV coordinates in the Spacecraft/Launch Vehicle ICD **shall** be provided.

The Spacecraft Mission Insignia **shall** be a joint development effort between the Government and Spacecraft Contractor.

The Spacecraft Mission Insignia submittal **shall** provide a color rendition of the Mission Insignia, which will be scaled by the Launch Vehicle contractor to occupy the largest available area designated for this application.

Definition of the Spacecraft Mission Insignia **shall** be required by the Spacecraft/Launch Vehicle ICD.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
PS-01	**Orbital Activation Plan**

3. Use:

This document provides the baseline for the orbital activation procedures.

4. Preparation Information:

The information in this plan shall include the orbital activation concept, scenario, external interfaces and schedules.

It shall also include a failure recovery plan and any contingency operations plans.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u> **2. <u>Title:</u>**

PS-02 **Flight Operations Training Plan**

3. <u>Use:</u>

This document will identify the approach to be taken for training of the flight operators and the resources and schedule required for training.

4. <u>Preparation Information:</u>

This document shall define the training to be provided to the flight operation personnel for the GOES-R spacecraft.

The training resources and schedules required shall be identified.

Training procedures and material to be developed and certification procedures shall be identified.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u>	**2. <u>Title:</u>**
PS-03	**Spacecraft Training Program Plan**

3. <u>Use:</u>

This defines and describes training required to prepare the operations staff with complete understanding of spacecraft operations modes and anomaly recovery.

4. <u>Preparation Information:</u>

This document shall define the training to be provided to the flight operation personnel for the GOES-R spacecraft.

It shall cover training approach, certification procedures, resources required and the schedule.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.:	**2. Title:**
PS-04	**Spacecraft Mission Operations Plan**

3. Use:

Provides an overview of all Contractor mission operations support activities.

4. Preparation Information:

The Mission Operations Plan shall include the following minimum material.

1) **Mission operations organization for all launch and on-orbit phases**
2) **Overview of Mission Profile through spacecraft end-of-life**
3) **Characteristics of Ground Network for all launch and on-orbit phases**
4) **Overview of ETE program**
5) **Overview of spacecraft operations timelines for all launch and on-orbit phases**
6) **Ground system operations and INR Performance Verification**
7) **Staffing Plan for mission duration**
8) **Orbit Determination/Maneuver Planning Methodology**

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: **2. Title:**

PS-05 **Spacecraft On-Orbit Storage Plan**

3. Use:

Provide a plan for implementing on-orbit storage of GOES-R.

4. Preparation Information:

The contractor shall provide a detailed plan for on-orbit storage of the GOES satellites. The On-Orbit Storage Plan shall describe the following:

1) **Impact of prolonged storage on S/C operational lifetime, including expendables.**
2) **Spacecraft requirements for communications and control during on-orbit storage.**
3) **Define and describe recommended on-orbit S/C storage mode configuration including GFP instruments, operations constraints and requirements, including analyses when appropriate, to support proposed recommendations.**
4) **Recommended plan for removal from on-orbit storage, including recommended retest plan.**
5) **Spacecraft operations personnel requirements for monitoring S/C health and safety, including any necessary S/C commanding operations.**
6) **Recommended spacecraft telemetry points and telemetry limits that should be monitored by the NOAA operations personnel.**

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. <u>CDRL No.:</u> **2. <u>Title:</u>**

PS-06 **Spacecraft De-Orbit Plan**

3. <u>Use:</u>

Provides detailed de-orbit and spacecraft shut down procedures.

4. <u>Preparation Information:</u>

This plan includes estimated end of life system requirements to achieve proper super-synchronous orbit.

This plan details the exact order of operations required to perform and verify the controlled termination of the mission.

Provide criteria for decision to end spacecraft lifetime. Describe detailed procedure for placing spacecraft beyond geosynchronous orbit and performing a controlled turn off of all satellite subsystems and payloads.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: **2. Title:**

PS-07 **Spacecraft Ground System Test Data**

3. Use:

This document will be used in support of ground system testing.

4. Preparation Information:

The Spacecraft Ground System Test Data shall define the interface for the exchange of data produce during spacecraft integration and test.

The interface for the GOES generated command data and spacecraft/instrument generate telemetry shall be defined and documented in the Spacecraft Ground System Test Data.

Effective Date: (Date of last signature)

DATA ITEM DESCRIPTION

1. CDRL No.: PS-08

2. Title: Spacecraft Engineering Handover Review

3. Use:

Provide government personnel with a status of the spacecraft at the start of post launch testing.

4. Preparation Information:

The spacecraft contractor shall provide the following information in this review:

1) Data review (in the form of data plots/tables) of the results of operational performance identified during the LOR and bus checkout.
2) Data review (in the form of data plots/tables) of diurnal signatures for key components (controls, power, thermal)
3) Data review (in the form of data plots/tables) for all anomalies and unexpected behavior encountered by the spacecraft contractor during LOR and bus checkout, including:
    a. Data showing the anomalous or unexpected behavior
    b. Current status of their investigation and resolution
    c. Descriptions of any workarounds and/or fixes
    d. Data illustrating response to the workarounds and/or fixes
4) Current status of all ground system problems, and database problems encountered by the spacecraft contractor during LOR and bus checkout
    a. Current status of their investigation and resolution
    b. Descriptions of any workarounds and/or fixes
    c. Data illustrating response to the workarounds and/or fixes
5) Current detailed spacecraft equipment configuration
6) Current detailed FSW configuration (status of RAM data changed since launch)
7) Current spacecraft orbit solution (on day of handover)
8) Current spacecraft propellant remaining including comparison with pre-launch budget predictions
9) List of current operations objective liens (i.e., what planned activities have not been accomplished)
10) Description of any new operational constraints and procedure changes including description of any operational workarounds implemented

Effective Date: (Date of last signature)

DOCUMENT CHANGE RECORD

CCR #
Contract #
CCB Status:
Mod #
Change Date:

GOES S/C:
CCR Summary:
CDRL #

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